U.S. DEPARTMENT OF ENERGY
NUCLEAR AWARDEE™

2025

Collaboration-Based Siting for Management of Spent Nuclear Fuel in the United States: Body of Knowledge (BoK) for Practitioners

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Disclaimer

The report is also partially based on work supported by the U. S. Department of Energy, under Cooperative Agreement Number DE-FC01-06EW07053 entitled 'The Consortium for Risk Evaluation with Stakeholder Participation III' awarded to Vanderbilt University. The opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily represent the views of the Department of Energy or Vanderbilt University.

Acknowledgements

The authors would like to express their gratitude to Mr. Allen Croff, for serving as an independent reviewer of the BoK.

[1] In early 2025, the DOE program underwent a name change from Consent-Based Siting to Collaboration-Based Siting (CBS).

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How to Use this Report

The primary purpose of this Body of Knowledge (BoK) is to comprehensively identify, summarize, and share the state of knowledge documented within recent literature that captures experiences and lessons learned regarding the concepts of trust, risk communication, risk-informed decision-making tools and frameworks, and compensation—as they might pertain to collaboration-based siting (CBS). In addition, relevant historical background is provided. The primary audience of this BoK is practitioners of (or those who will in the future practice) CBS. At the time of publication, this audience includes the U.S. Department of Energy, Office of Nuclear Energy (DOE-NE) and its CBS Consortia. As DOE-NE moves into subsequent phases of its CBS process, the audience of the BoK is expected to grow, e.g., to facilitators preparing for and leading stakeholder and Tribal engagements, interested host communities looking to learn about CBS, negotiators involved in crafting benefits packages for a potential host site, etc. Given the anticipatedly variegated audience of this report, we offer suggestions for how to use this report below.

For those looking to…	**Refer to**
Understand the historical context for hazardous facility siting in the United States.	Preface, followed by Chapter 2
Learn more about DOE-NE's CBS process and the Consortium for Risk Evaluation with Stakeholder Participation (CRESP) project.	Section 1.1
Understand the temporal, industrial, geographic, and data limits of the references included in the BoK.	Section 1.2.3
Learn more about the Monitored Retrievable Storage (MRS) initiative and its long-term implications.	Section 2.2 & 2.3
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Review the process used to select references for inclusion in the BoK.	Chapter 3

For those looking to…	Refer to
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Identify or select between tools that can be used by potentially interested host communities to dialogue and deliberate with each other.	Chapter 5
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Acronyms & Abbreviations

AEC	Atomic Energy Commission
APM	Adaptive Phased Management
ASLB	Atomic Safety and Licensing Board
BANANA	Build Absolutely Nothing Anywhere Near Anyone
BIA	Bureau of Indian Affairs (U.S.)
BLM	Bureau of Land Management (U.S.)
BoK	Body of Knowledge
BRC	Blue Ribbon Commission on America's Nuclear Future
CAB	Citizens Advisory Board
CBS	Collaboration-Based Siting
CDC	Centers for Disease Control and Prevention (U.S.)
CEMRC	Carlsbad Environmental Monitoring and Research Centre
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CISF	Consolidated Interim Storage Facility
CLAMP	Concentrating Locations at Major Plants
CLC	Community Liaison/Advisory Committee
CPUC	California Public Utilities Commission
CRESP	Consortium for Risk Evaluation with Stakeholder Participation
DOE	Department of Energy (U.S.)
DOE-EM	Department of Energy, Office of Environmental Management (U.S.)

DOE-NE	Department of Energy, Office of Nuclear Energy (U.S.)
DOI	Department of Interior (U.S.)
ECAST	Expert and Citizen Assessment of Science and Technology
EDRAM	International Association for Environmentally Safe Disposal of Radioactive Materials
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (U.S.)
EPRI	Electric Power Research Institute
ES&H	Environment, Safety, and Health
FERC	Federal Energy Regulatory Commission (U.S.)
GAO	Government Accountability Office (U.S.)
HLW	High-level Waste
IRG	Interagency Review Group
ISFSI	Independent Spent Fuel Storage Installation
ISP	Interim Storage Partners
ITEK	Indigenous Traditional Ecological Knowledge
KEP	Knowledge Exchange Portal
LILW	Low and Intermediate-level Waste
LNG	Liquefied Natural Gas
LULU	Locally Unwanted Land Use
MFP	Mothers for Peace
MRS	Monitored Retrievable Storage
MW	Megawatt
NAIMBY	Not Always in my Backyard

NCAI	National Congress of American Indians
NCDD	National Coalition for Dialogue & Deliberation
NDAA	National Defense Authorization Act
NEIMA	Nuclear Energy Innovation and Modernization Act
NEPA	National Environmental Policy Act
NETWG	Nuclear Energy Tribal Working Group
NHPA	National Historic Preservation Act
NIABY	Not in Anyone's Backyard
NIMBY	Not in my Backyard
NIMTOO	Not in my Term of Office
NPL	National Priorities List
NRC	Nuclear Regulatory Commission (U.S.)
NWMO	Nuclear Waste Management Organization (Canada)
NWPA	Nuclear Waste Policy Act
NWTRB	Nuclear Waste Technical Review Board
OECD	Organization for Economic Cooperation and Development
OECD-NEA	Organization for Economic Cooperation and Development-Nuclear Energy Agency
OGD	Ohngo Gaudadeh Devia
ONWN	Office of the Nuclear Waste Negotiator
OREM	Oak Ridge Office of Environmental Management
OSHA	Occupational Safety and Health Administration (U.S.)
PFS	Private Fuel Storage, LLC
PG&E	Pacific Gas and Electric Company

PWR	Pressurized Water Reactor
RCRA	Resource Conservation and Recovery Act
SKB	Swedish Nuclear Fuel and Waste Management Company
SNF	Spent Nuclear Fuel
STMCE	Socio-technical Multi-criteria Evaluation
TENORM	Technically Enhanced Naturally-Occurring Radioactive Material
TISE	Take it Somewhere Else
TOADS	Temporarily Obsolete Abandoned Derelict Sites
TRU	Transuranic Waste
URL	Underground Research Laboratories
WCDC	Wayne County Development Board
WESER	Waste and Source Reduction
WIPP	Waste Isolation Pilot Plant

Glossary

Note: Term definitions may vary across sources and context of usage. These terms are used with the following definitions within this report. Where possible, terminology definitions are taken from authoritative guidance.

AmericaSpeaks 21st Century Town Meeting

Source: NCDD (2014)

Definition: A dialogue and deliberation process used to *engage large groups of citizens using innovative technology to provide direct feedback to leaders.*

See also: National Issue Forum; Citizens Jury; Deliberative Polling; Public Agenda's Citizen Choicework; Charrettes; Consensus Conferences

Blue Ribbon Commission on America's Nuclear Future (BRC)

Source: DOE (2024a)

Definition: *In 2010, the Secretary of Energy established the Blue Ribbon Commission on America's Nuclear Future (BRC) at the request of the President to conduct a comprehensive review of policies for managing the back-end of the nuclear fuel cycle. It recommended a new "plan of action for the management and disposal of the nation's used nuclear fuel and high-level radioactive waste."*

The BRC issued a final report in January 2012 that reaffirmed the broad outlines of the Nuclear Waste Policy Act of 1982, as originally enacted, but made recommendations to reset the program and restart progress toward a long-term solution to the spent nuclear fuel and high-level nuclear waste issue. Key recommendations included establishing a new entity to manage the U.S. nuclear waste program, establishing capacity for consolidated interim storage, and using a collaboration-based process *to site future storage and disposal facilities.*

Body of Knowledge

Source: EPRI (2018)

Definition: *A "body of knowledge" (BoK) is a manageably-sized collection of specifically selected references that has been developed and employed by professional groups to promote education and common understanding of a particular subject area, practice, or discipline…The BoK generally takes the form of a curated collection of document citations accompanied by brief descriptions and relevant notes about the use of each document. A BoK is a guide to a library of documents, not the library itself, providing just enough information about each document to convey a sense of its content and purpose relative to the BoK domain.*

Capacity Building

Source: DOE (2024a)

Definition: *Capacity building is a process of fostering mutual understanding, establishing collaborative partnerships, and laying the foundations for wider-reaching community participation and stakeholder engagement. Supported by DOE's 2022 Funding Opportunity Announcement, DOE's* CBS *Consortia is spending two years focused on building capacity. The consortia's activities contribute to Stage 1 of DOE's* CBS *Process: Planning and Capacity Building. This stage involves building relationships and developing a common understanding of nuclear waste management and associated topics. The* CBS *Consortia is responsible for fostering community discussion and capturing feedback on the interim storage of spent nuclear fuel. The consortia will also provide resources for communities and organizations to learn more about* CBS*, the management of spent nuclear fuel, and federal consolidated interim storage.*

Charrettes

Source: NCDD (2014)

Definition: *A collaborative design method that involves all stakeholders in a continual feedback loop to reach a consensus.*

See also: National Issue Forum; Citizens Jury; Deliberative Polling; Public Agenda's Citizen Choicework; AmericaSpeaks' 21st Century Town Meetings; Consensus Conferences

Citizens Advisory Board (CAB)

Source: EPA (2024)

Definition: *Citizen advisory boards are known by many names—boards, committees, groups, task forces, etc. Citizen advisory boards consist of a representative group of stakeholders from a particular community appointed to provide comments and advice on a project or issue.*

Boards generally meet on a regular schedule over a period of time to develop a detailed knowledge of the project and issues and to share their relevant perspectives, ideas, concerns, and interests. Boards often work to identify areas of common ground and/or consensus recommendations.

See also: site-specific advisory board

Other commonly used terms: community engagement panel; community advisory panel; community advisory board

Citizens Jury

Source: NCDD (2014)

Definition: *A method where a microcosm of the public deliberates for several days before issuing recommendations.*

See also: National Issue Forum; Deliberative Polling; Public Agenda's Citizen Choicework; AmericaSpeaks' 21st Century Town Meetings; Charrettes; Consensus Conferences

Consensus Conference

Source: NCDD (2014)

Definition: A dialogue and deliberation method that *involve*[s] *representative group of citizens in discussing scientific or technical issues in stages, culminating in a public presentation of conclusions.*

See also: National Issue Forum; Deliberative Polling; Public Agenda's Citizen Choicework; AmericaSpeaks' 21st Century Town Meetings; Charrettes; Citizens Jury

Collaboration-based Siting (CBS)

Source: DOE (2024a)

Definition: The CBS *process is designed to be flexible, adaptive, and responsive to community concerns. DOE is committed to using a* collaboration-based *process to site one or more federal consolidated interim storage facilities for commercial spent nuclear fuel. Communities that volunteer to participate in the siting process will work with DOE through a series of stages. The stages are intended to serve as guidelines to help a community determine if and how hosting a facility is aligned with its goals.* CBS *processes evolve and are strengthened through ongoing engagement with communities, including Tribes, States, local governments, and other interested parties. Lessons learned from these efforts can also inform the future development of other facilities, such as a deep geologic repository.*

Consolidated Interim Storage Facility [CISF] (Federal)

Source: DOE (2024a)

Definition: *This is a facility that would enable the near-term consolidation of spent nuclear fuel from multiple storage sites across the country. Managing spent nuclear fuel and high-level radioactive waste is DOE's legal responsibility. Federal consolidated interim storage is an important component of DOE's integrated waste management system. Spent nuclear fuel is currently stored at more than seventy sites across the country. Reducing the number of locations where spent nuclear fuel is stored can provide several benefits, such as easing the burden on U.S. taxpayers, promoting new jobs, and creating economic opportunities. Congress directed DOE to move forward, under existing authority, to identify site(s) for one or more federal consolidated interim storage facilities for spent nuclear fuel. Federal consolidated interim storage is referred to as "monitored retrievable storage" in the Nuclear Waste Policy Act of 1982, as amended.*

See also: dry cask storage; independent spent fuel storage installation (ISFSI); consolidated interim storage facility (private/commercial)

Consolidate Interim Storage Facility [CISF] (Private/Commercial)

Source: DOE (2024a)

Definition: *This is a facility that would enable the near-term consolidation of spent nuclear fuel from multiple storage sites across the country. The authority of NRC to license a private entity to construct and operate a consolidated interim storage facility is in question given recent decisions by the U.S. Court of Appeals for the Fifth Circuit holding that NRC does not have such authority. The court vacated the NRC license issued to Interim Storage Partners, LLC (a joint venture between Waste Control Specialists LLC [WCS] and Orano CIS LLC) for a proposed commercial consolidated interim storage facility in Texas. In a separate case, the court vacated the NRC license issued to Holtec International for a proposed commercial consolidated interim storage facility in New Mexico.* A supreme court decision on the matter is expected in Summer of 2025.

See also: dry cask storage; independent spent fuel storage installation (ISFSI); consolidated interim storage facility (federal)

CURIE

Source: DOE (2024a)

Definition: *CURIE is a resource portal for DOE nuclear waste management information that provides usable, collaborative document and data access to industry, vendors, government, national laboratory partners, academia, and the general public. Please note that CURIE is distinct from a "curie" (in lower case letters), which is a unit used to measure the decay of radioactivity with time.*

Deep Geologic Repository

Source: NRC (2023c)

Definition: *An excavated, underground facility that is designed, constructed, and operated for safe and secure permanent disposal of HLW [including SNF]. A* [deep] *geological repository uses an engineered barrier system and a portion of the site's natural geology, hydrology, and geochemical systems to isolate the radioactivity of the waste.*

Other commonly used terms: geological repository; repository; deep geologic disposal

Deliberative Polling

Source: NCDD (2014)

Definition: A dialogue and deliberation process that *combines small group deliberations with scientific random sampling to provide public consultation on policy issues.*

See also: National Issue Forum; Citizens Jury; Public Agenda's Citizen Choicework; AmericaSpeaks' 21st Century Town Meetings; Charrettes; Consensus Conferences

Distributive Justice

Source: Cohen (2017)

Definition: *Justice (and its lack) in the distribution of benefits and burdens to individuals.*

Refer also to: procedural justice; recognition justice; restorative justice

Dry Cask Storage

Source: DOE (2024a)

Definition: *Dry [cask] storage refers to the storage of spent nuclear fuel in dry (out-of-water) conditions. Typically, spent nuclear fuel in dry storage is contained in aboveground dry storage casks on a concrete pad, although other dry storage system concepts have been designed including underground silos and aboveground or belowground vaults with some currently in use.*

See also: Independent spent fuel storage installation (ISFSI); consolidated interim storage facility (private/commercial); consolidated interim storage facility (federal)

Environmental Assessment (EA)

Source: DOE (2024a)

Definition: *A concise public document that a federal agency prepares under the National Environmental Policy Act (NEPA) to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement or a finding of no significant impact. An environmental assessment is distinct from an environmental impact statement (EIS).*

See also: Environmental Impact Statement (EIS)

Environmental Impact Statement (EIS)

Source: DOE (2024a)

Definition: *The detailed written statement that is required by the National Environmental Policy Act (NEPA) for a proposed major federal action significantly affecting the quality of the human environment.*

See also: Environmental Assessment (EA)

Fairness

Source: Cambridge University Press (2025)

Definition: *The quality of treating people equally or in a way that is right or reasonable.*

Government-to-Government Relationship

Source: DOE (2000)

Definition: *Tribes are sovereign governments. Before Europeans first sailed to America, the tribes were already sovereign by nature. They conducted their own affairs and depended upon no other*

source of power to uphold their acts of government. The U.S. Constitution recognizes four sovereign governmental entities: the Federal government, state governments, American Indian Tribal governments, and foreign nations. American Indian Tribes, though uprooted and removed to reservations, retain inherent sovereignty. The United States did not grant Tribal rights, rather, Tribes reserved such rights as part of their preexisting status as sovereign nations.

Tribes are not treated as mere administrative extensions of federal programs, but as separate governments. They are sovereign entities, recognized in the U.S. Constitution with rights and privileges negotiated in treaties and defined in case law. Interaction with federally recognized Tribes must be conducted on a government-to-government basis. This is in addition to and goes beyond any public involvement and community -outreach efforts.

See also: Tribal sovereignty

High-Level Waste (HLW)

Source: NWPA (1993)

Definition: (*A) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and*

(B) Other highly radioactive material that the [Nuclear Regulatory] Commission, consistent with existing law, determines by rule requires permanent isolation.

See also: Low-level waste (LLW); transuranic waste (TRU)

Independent Spent Fuel Storage Installation (ISFSI)

Source: DOE (2024a)

Definition: *This is a facility licensed by the U.S. Nuclear Regulatory Commission (NRC) for storing spent nuclear fuel. All ISFSIs in the United States are dry storage facilities, except for one wet (pool) storage facility. Most ISFSIs are located at operating or shutdown nuclear power plant sites. Although the primary purpose of an ISFSI is to store spent nuclear fuel, it can also store greater-than-Class-C low-level radioactive waste from reactor decommissioning activities.*

See also: dry cask storage; consolidated interim storage facility (private/commercial); consolidated interim storage facility (federal)

Indigenous Traditional Ecological Knowledge (ITEK)

Source: Lander & Mallory (2021)

Definition: *ITEK is a body of observations, oral and written knowledge, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems. It is applied to phenomena across biological, physical, cultural and spiritual systems. ITEK has evolved over millennia, continues to evolve, and includes insights based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills*

passed from generation to generation. ITEK is owned by Indigenous people—including, but not limited to, Tribal Nations, Native Americans, Alaska Natives, and Native Hawaiians.

**Note: We acknowledge that the term "Indigenous Traditional Ecological Knowledge" is not recognized or favored by all Indigenous peoples today, and that terms such as "Indigenous Knowledges" or "Other Knowledges" may be more accurate. We have chosen to use this terminology in limited capacity within this report to be consistent with the terminology used in the funding vehicle for this work, DE-FOA-0002575, *Collaboration-Based Siting for Interim Storage Program -- Community Engagement Opportunities*.

Other commonly used terms: Indigenous knowledge; traditional ecological knowledge; traditional knowledge

Integrated Waste Management System

Source: DOE (2024a)

Definition: *DOE is planning for an integrated waste management system to transport, store, and dispose of our nation's spent nuclear fuel and high-level radioactive waste. An integrated waste management system consists of the sites, facilities, systems, equipment, materials, information, activities, and personnel required to perform those functions. This includes a transportation system to move spent nuclear fuel and high-level radioactive waste from one place to another, a consolidated interim storage system, and eventually a disposal system to provide a pathway to permanent disposal.*

Knowledge Exchange Portal

Source: Quinn et al. (2014)

Definition: *A platform for two-way collaboration and exchange among people in different organisations or professions… KEPs* [Knowledge Exchange Portals] *can facilitate knowledge management through three core activities…: (i) knowledge access, by providing a single integrated point of access to a variety of relevant organisational or topic-specific information; (ii) knowledge creation, by creating and maintaining knowledge directories about portal generated content; and (iii) knowledge transfer and exchange, by facilitating information sharing and distribution and providing collaborative features that help to foster communities of practice.*

See also: socio-technical multi-criteria evaluation (STMCE); open process workshop

Location Science

Source: Gbenga Ajayi, O. (2024)

Definition: *A multidisciplinary field that encompasses the study of spatial patterns, relationships, and processes to analyze and understand the geographic distribution of phenomena and inform decision-making in various domains such as urban planning, transportation, and environmental management.*

Low-Level Waste (LLW)

Source: NRC (2023d)

Definition: *A general term for a wide range of waste that is contaminated with radioactive material or has become radioactive through exposure to neutron radiation. A variety of industries, hospitals and medical institutions, educational and research institutions, private or government laboratories, and nuclear fuel cycle facilities generate LLW. Some examples include radioactively contaminated protective shoe covers and clothing; cleaning rags, mops, filters, and reactor water treatment residues; equipment and tools; medical tubes, swabs, and hypodermic syringes; and carcasses and tissues from laboratory animals.*

See also: high-level waste (HLW); transuranic waste (TRU)

Monitored Retrievable Storage (MRS)

Source: DOE (1991)

Definition: *An integral part of the Federal waste-management system, an MRS will temporarily store spent fuel shipped to it from commercial nuclear power plants and will stage shipments of the spent fuel to a geologic repository for permanent disposal.*

**Note: MRS was the term used to describe a consolidated interim storage facility (CISF) while the Office of the Nuclear Waste Negotiator (ONWN) was active. CISF is now the preferred term.

See also: Office of the Nuclear Waste Negotiator (ONWN)

National Issues Forum

Source: NCDD (2014)

Definition: *These forums allow citizens to deliberate, make choices, and work toward reasoned public judgment, featuring carefully framed issues presented from multiple viewpoints.*

See also: National Issue Forum; Citizens Jury; Deliberative Polling; Public Agenda's Citizen Choicework; AmericaSpeaks' 21st Century Town Meetings; Charrettes; Consensus Conferences

Nuclear Waste Fund (NWF)

Source: DOE (2024a)

Definition: *The Nuclear Waste Policy Act (NWPA) created a funding mechanism intended to ensure that the full costs of disposing of commercial spent nuclear fuel and high-level radioactive waste would be paid by the owners and generators of such waste, primarily nuclear utilities (and their ratepayers). Under contracts entered with owners and generators of commercial spent nuclear fuel and high-level radioactive waste, nuclear utilities were assessed a fee on every kilowatt-hour of electricity generated and sold in exchange for the federal government's contractual commitment to provide for permanent disposal of commercial spent nuclear fuel and high-level radioactive waste. Fees are deposited into the Nuclear Waste Fund (NWF), which was established in the U.S. Treasury to ensure that the costs of carrying out activities relating to the disposal of such waste and spent fuel will be borne by the persons responsible for generating*

such waste and spent fuel. Amounts in the NWF in excess of current needs are invested in U.S. Treasury securities which accrue interest income and gains. The NWF balance was approximately $47.7 billion as of September 30, 2023. In compliance with a November 2013 court ruling, the fee was adjusted to zero effective in May 2014.

Nuclear Waste Policy Act (NWPA)

Source: DOE (2024a)

Definition: *Among other functions, the Nuclear Waste Policy Act of 1982, as amended (NWPA), assigns DOE the responsibility to find sites to store and eventually dispose of high-level radioactive waste and spent nuclear fuel. It directs the U.S. Environmental Protection Agency (EPA) to develop standards for protection of the general environment from offsite releases of radioactive material in repositories. The NWPA directs the U.S. Nuclear Regulatory Commission (NRC) to license DOE to operate a repository only if it meets EPA's standards and all other relevant requirements.*

Nuclear Waste Technical Review Board (NWTRB)

Source: DOE (2024a)

Definition: *The U.S. Nuclear Waste Technical Review Board (NWTRB) is an independent federal agency in the executive branch of the U.S. federal government. The NWTRB's purpose is to perform independent technical and scientific peer review of DOE's activities related to managing and disposing of high-level radioactive waste and spent nuclear fuel. The Board reports its findings and recommendations to Congress and the Secretary of Energy*.

Office of the Nuclear Waste Negotiator (ONWN)

Source: Section 2.2

Definition: The Nuclear Waste Policy Amendments Act of 1987 established the federal Office of the Nuclear Waste Negotiator. The ONWN was to attempt to find a state or Tribal Nation willing to host an MRS facility for the temporary storage of SNF generated by commercial power plants. **Note: The ONWN did not meet its goal and is now defunct.

See also: Monitored Retrievable Storage (MRS)

Open Process Workshop

Source: Rossignol et al. (2014)

Definition: Open Process Workshop *includes an exercise of interactive mental mapping, which constitutes a privileged access to very personal cognitive representations of a situation, by capturing how people make sense of their world.*

Participatory Decision-Making

Source: Section 5.1

Definition: Methods, tools, and frameworks that allow for members of an interested host community to dialogue and deliberate with each other to reach decisions on not just "yes" or "no" siting questions, but on their visions for their communities, desired benefits, perceived risks, etc.

Procedural Justice

Source: Yale Law School (2025)

Definition: *Procedural justice speaks to the idea of fair processes and how people's perception of fairness is strongly impacted by the quality of their experiences and not only the end result of these experiences.*

See also: distributive justice; recognition justice; restorative justice

Public Agenda's Citizen ChoiceWork

Source: NCDD (2014)

Definition: A dialogue and deliberation process *that facilitates discussions on tough choices, helping participants navigate values conflicts and practical trade-offs.*

See also: National Issue Forum; Citizens Jury; Deliberative Polling; National Issues Forums; AmericaSpeaks' 21st Century Town Meetings; Charrettes; Consensus Conferences

Recognition Justice

Source: Fraser (1998)

Definition: …*involves the assessments of institutionalized patterns of cultural valuation and distinctiveness and the identification and removal of those unjust value hierarchies that obstruct equal respect and esteem*.

See also: restorative justice; procedural justice; distributive justice

Site-specific Advisory Board (SSAB)

Source: DOE (2024b)

Definition: *The EM Site-Specific Advisory Board (EM SSAB) was created to involve stakeholders more directly in EM cleanup decisions…*

In accordance with its charter, the EM SSAB exists to provide the EM senior management with information, advice and recommendations concerning issues affecting the EM program at various sites. Specifically, at the request of the Assistant Secretary or the site managers, the board may provide advice and recommendations concerning the following EM site-specific issues: clean-up activities and environmental restoration; waste and nuclear materials

management and disposition; excess facilities; future land use and long-term stewardship; risk assessment; and communications.

The EM SSAB's activities are governed by the Federal Advisory Committee Act (FACA), which was enacted to ensure that the general public has access to advisory board deliberations and recommendations. While only one FACA-chartered EM SSAB exists, eight local boards have been organized under its umbrella charter. They include the Hanford Advisory Board, Idaho Cleanup Project Citizens Advisory Board, Northern New Mexico Citizens' Advisory Board, Nevada SSAB, Oak Ridge SSAB, Savannah River Site Citizens Advisory Board, Portsmouth SSAB and Paducah Citizens Advisory Board.

See also: citizens advisory board (CAB)

Socio-technical Multi-criteria Evaluation (STMCE)

Source: Diaz-Maurin et al. (2021)

Definition: *The STMCE approach consists of (i) a multi-criteria evaluation that provides an ordinal ranking of alternatives based on a list of criterion measurements; and (ii) a social impact analysis that provides an outranking of options based on the assessment of their impact on concerned social actors.*

Spent Fuel Recycling/Reprocessing

Source: DOE (2024a)

Definition: *Spent nuclear fuel can be recycled to make new fuel and beneficial byproducts. More than 90% of its potential energy still remains in the fuel, even after five years of operation in a reactor. The United States does not currently recycle spent nuclear fuel, but foreign countries such as France do. There are some advanced reactor designs currently under development that could consume or run on spent nuclear fuel in the future. A portion of the growing spent nuclear fuel inventory might be suitable for recycling/reprocessing and reuse in nuclear reactors.*

Spent Nuclear Fuel (SNF)

Source: DOE (2024a)

Definition: *Spent nuclear fuel (SNF) refers to the nuclear fuel that has been used in a reactor. The fuel used in today's commercial reactors is made up of small ceramic pellets of low-enriched uranium oxide. The fuel pellets are stacked vertically and encased in a metallic cladding to form a fuel rod. These fuel rods are bundled together into tall fuel assemblies that are then placed into a reactor. After about five years, nuclear fuel used in reactors is no longer efficient as a source of energy and it must be replaced with fresh nuclear fuel. The Nuclear Waste Policy Act defines spent nuclear fuel as fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.*

Spent nuclear fuel mostly consists of uranium, with a small percentage of radioactive fission products, and an even smaller percentage of heavy radioactive elements such as plutonium and americium. Spent nuclear fuel retains heat and radioactivity and, therefore, must be handled, stored, and ultimately disposed of in a safe and secure manner that protects human health and

the environment. In the U.S., commercial nuclear power produces about 2,000 metric tons of spent nuclear fuel per year. U.S. commercial reactors have generated about 90,000 metric tons of spent nuclear fuel since the 1950s. Spent nuclear fuel is also sometimes referred to as "used nuclear fuel" or "spent fuel."

Other commonly used terms: used nuclear fuel

Stakeholder

Source: International Organization for Standardization (2013)

Definition: *A party having a right, share, claim, or interest in* the siting of a facility for managing (or disposing) of radioactive material. This includes private citizens (including disadvantaged populations and communities), local and state elected officials, non-governmental organizations, members of advisory boards, and others. Tribal Nations are interested parties in the CBS of a federal CISF but are referred to distinctly within this research to respect their preferences and status as sovereign nations.

Transuranic Waste (TRU)

Source: DOE (2024a)

Definition: *TRU waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61 TRU waste often consists of clothing, tools, rags, residues, debris, soil and other items contaminated with small amounts of plutonium and other man-made radioactive elements. DOE's Waste Isolation Pilot Plant (WIPP) is the United States' geologic repository for the disposal of the nation's defense-related TRU waste.*

Tribal Consultation

Source: BIA (n.d.)

Definition: *A Tribal consultation is a formal, two-way, government-to-government dialogue between official representatives of Tribes and Federal Government agencies to discuss federal proposals before the federal agency makes decisions on those proposals. The federal agency provides sufficient advance notice to appropriate Tribal leaders of upcoming consultation sessions and, following the consultation sessions, explains to those Tribal leaders how the final agency decision incorporates Tribal input.*

See also: Tribal sovereignty; government-to-government relationship; trust responsibility

Tribal Sovereignty

Source: NCAI (2019)

Definition: *Tribal citizens are citizens of three sovereigns: their Tribal Nations, the United States, and the state in which they reside. They are also individuals in an international context with the rights afforded to any other individual.*

Sovereignty is a legal word for an ordinary concept— the authority to self-govern. Hundreds of treaties, along with the Supreme Court, the President, and Congress, have repeatedly affirmed that Tribal nations retain their inherent powers of self-government. These treaties, executive orders, and laws have created a fundamental contract between Tribal Nations and the United States. Tribal Nations are located within the geographic borders of the United States, while each Tribal Nation exercises its own sovereignty.

See also: government-to-government relationship; trust responsibility; Tribal consultation

Trust Responsibility

Source: BIA (2017)

Definition: *The federal Indian trust responsibility is a legal obligation under which the United States "has charged itself with moral obligations of the highest responsibility and trust" toward Indian tribes (Seminole Nation v. United States, 1942). This obligation was first discussed by Chief Justice John Marshall in Cherokee Nation v. Georgia (1831). Over the years, the trust doctrine has been at the center of numerous other Supreme Court cases, thus making it one of the most important principles in federal Indian law.*

The federal Indian trust responsibility is also a legally enforceable fiduciary obligation on the part of the United States to protect Tribal treaty rights, lands, assets, and resources, as well as a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes and villages. In several cases discussing the trust responsibility, the Supreme Court has used language suggesting that it entails legal duties, moral obligations, and the fulfillment of understandings and expectations that have arisen over the entire course of the relationship between the United States and the federally recognized tribes.

See also: Tribal consultation; Tribal sovereignty; government-to-government relationship

Waste Isolation Pilot Plant (WIPP)

Source: DOE (2024a)

Definition: *DOE's Waste Isolation Pilot Plant (WIPP) is the country's only geologic repository to permanently dispose of the nation's defense-related TRU waste. WIPP is located twenty-six miles southeast of Carlsbad, New Mexico, in the Chihuahuan Desert. Waste is disposed of in a set of panels located nearly one-half mile below the surface in a deep geologic salt bed formed 250 million years ago. The facility began operation in 1999. WIPP has received approximately 13,000 shipments.*

See also: TRU; deep geologic repository

Wicked Problem

Source: Churchman (1967)

Definition: These problems are defined as being *ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing*

Preface

written by Michael Greenberg and Steve Krahn

Collaboration-based facility siting is an opportunity to negotiate win-win outcomes for the U.S. Department of Energy (DOE), individuals, community groups, for- and non-profit organizations, and state and municipal governments. However, care must be taken in the development and application of collaboration-based approaches for facility siting, given the history of unsuccessful attempts at siting facilities for managing (or disposing) of radioactive material in the U.S. and abroad—even those founded on similar principles to DOE's current collaboration-based siting (CBS) initiative. Achieving success requires negotiating agreements between parties through processes that are remarkably different from historic practices. While it is tempting to go directly to discussing CBS of spent nuclear fuel (SNF) management facilities, it is important to first understand the history of hazardous facility siting. This preface briefly reviews three following contextual elements:

1. Top-down and technocratic location processes that have been in-place for well over a century;
2. Evolution from top-down processes to processes based on cooperation and negotiation; and
3. The role of trust as a cornerstone in modern socio-technical communication and engagement efforts undertaken to achieve CBS, including the competence, communications, and value-based elements of trust.

a. Historical Context for CBS: The Top-Down Approach

What is referred to today as CBS is remarkably different from traditional siting practices used for much of the last century by business and government. We begin with introductions to technocratic location science practiced by business interests for siting large chemical, oil, steel, electricity generation, and many other manufacturing facilities, as well as a version of location science practiced by government agencies, including the Atomic Energy Commission (AEC), the DOE, and the U.S. Nuclear Regulatory Commission (NRC) for siting commercial nuclear facilities.

a.i Early- to Mid-20th Century Practices: Location Science and the Top-Down Siting Process

Opportunities for community participation were limited or non-existent in traditional, technically oriented location science. The cornerstone of location practice from the start of the industrial revolution through the first three quarters of the 20th century was grounded in theories of German and U.S. economists and geographers who created the sub-discipline of "location science."[2] Location science was much more than a single academic course because the locations of manufacturing and manufacturing-related facilities were considered the primary driver of rapidly growing urban-industrial economies around the world (Blumenfeld, 1955; Davis, 1955; Pred, 1965, 1967; Tiebout, 1956; Weber, 1899).

The goal of location science was to find sites that would maximize business profits primarily by minimizing costs. Exemplified by iron and steel plants, factories were believed to be a key stimulator of wealth and jobs (Casetti, 1966; Isard & Cumberland, 1950; Kennelly, 1954; Rogers, 1952; Smith, 1971). The concentration of wealth was believed to attract creative people who would invent more wealth-building activities. The production sites, in turn, attracted retailing, wholesaling, and a surplus of wealth that led to building hospitals, public schools, zoos, and other attractions. The feedback loop between a successful industrial location and economic growth at that location was captured in the literature of the 1950s and 1960s by the distinction between "basic" industries that attract the wealth to create other businesses characterized as "non-basic" industries (Alexander, 1954; Hoyt, 1961; Roterus & Calef, 1955). Location science students were taught how to attract the set of basic industries. Retailing and wholesaling locations received much less attention; indeed, a popular saying during the 1960s was "you can't grow a local economy by washing each other's laundry" (to paraphrase).

Siting protocols focused on minimizing the costs of the business, which translated into finding a place where raw materials (e.g., coal, iron ore, bauxite) could be shipped at the lowest possible cost, and final products could be shipped to large nearby markets. Roads, railroads, and ports were critical to minimize costs. Low-cost financing was required to make sure that new sites could move forward as rapidly as possible. Government support was obtained through discussions with state and local government and private sector leaders who wanted to get the credit for growing the local economy. Thus, the traditional process of siting new production facilities required local governments and private sector leaders to use their powers and influence to find land, create infrastructure, and provide tax incentives to attract and retain manufacturing in support of adding jobs, tax revenues, and other local assets (Muncy, 1954; Wrigley,

[2] Over a half-century ago, the first author of this section taught industrial location theory to Columbia University business, economics, geography and related social science students.

1947). Air, land, and water pollution were not seriously considered until the mid-1960s. Labor supply was of limited concern because inexpensive labor was assumed to migrate to take high paying jobs.

This is not to say that there was no effort to protect the environment and engage communities. For example, the writings of Thoreau (1854), Marsh (1864), and the works of Muir (1901, 1912) testify to a growing awareness of the environmental and social burdens of the industrial revolution. The late 19th and early 20th centuries produced the U.S. Forest Service (1899) and the first National Parks (Yellowstone in 1872, Sequoia in 1890, and the Grand Canyon in 1908). Growing concern about air and water pollution led to major statutory changes in the late 1960s and 1970s (discussed below). Yet, before 1970, the U.S. experienced more than a century when profit was the clear priority. Public perceptions, concerns about the environment, and other non-economic factors were treated as external factors, in other words, "someone else's problems" to deal with after-the-fact. In the United States, due to the focus on economic factors, the so-called "announce and build" process ruled industrial location selection until the 1970s.

Then, with the passage of numerous environmental protection laws in the 1960s and 1970s, including, for example, the National Environmental Policy Act, Clean Water Act, and Clean Air Act, it became clear that senior elected officials and a growing proportion of the U.S. population wanted the U.S. government to move away from "announce and build"; the next step could be characterized as an "announce-defend-build" industrial location selection process that included some public access to siting processes and non-siting approaches (e.g., the addition of a new capability or facility at an existing site or the extension of a facility's mission beyond its original lifetime). The non-siting approaches included reducing the extent of contamination, such as concentrating locations at major plants (CLAMP) onto existing sites and locating them in other states or countries that wanted lead, steel, and other factories (Greenberg, 2018).

In short, individual and community concerns were tertiary for much of the 20th century. Profit maximization for business was the most important siting criterion by far. Public and community groups had some avenues for legal recourse (primarily civil suits), but the "defend" part of the long "announce-defend-build" era often left little room for them to make a difference.

a.ii Mid- to Late-20th Century: Nuclear Power and Top-Down Siting

The siting of nuclear power plants in the U.S. used a variant of technical location science that provided for limited community participation. In the beginning, the U.S. government was optimistic about nuclear power. President Eisenhower's Atoms for Peace speech in 1953 was intended to change perceptions from

the “destructive” atom to the “peaceful” one. Civilian nuclear power reactors for electricity generation were the key idea (Krahn & Sowder, 2024). By the early 1970s, government sources predicted that the U.S. would build 200 nuclear power plants of 1,000 megawatts and that “nuclear power was on the threshold of economic competitiveness” (AEC, 1962). About half of the predicted number of units for the United States were built, most during the 1970s (Energy Information Administration, 2017). At that time, management of SNF and other residuals was not a major topic of public discussion, as policy at that time assumed the spent fuel would be recycled.

Secrecy and concerns about security attached to weapons testing and production, along with the “Atoms for Peace” initiative in civilian nuclear power, carried over to the early siting processes under the AEC that limited deep involvement of local publics in siting. Government requirements were technical in nature and specified from the top-down to energy utilities. For example, the Code of Federal Regulations, Title 10, chapter 1, Part 100, *Reactor Site Criteria*, had three requirements: (1) an exclusion area surrounding the nuclear plant that is controlled by the licensee where public access is limited and residence is not normally allowed; (2) a “low population zone” surrounding the exclusion area where the number of residences is small enough to be evacuated or sheltered; and (3) a “population center distance,” which is the distance from the reactor to the nearest densely populated area of more than 25,000 residents (the distance should be at least 1.33 times the distance from the reactor to the outer boundary of the low population zone). Also, the applicant had to provide population projections for a 50-mile radius area surrounding the proposed site. This massive circular area was divided into 16 cardinal compass areas, and population projections were required for each sub-section of the circle.

The emphasis of these federal technical requirements was to reduce public exposure in the event of an accident, and fewer people in the area surrounding a nuclear power plant resulted in fewer people needing to be evacuated or sheltered during an accident scenario. Later, land use and demographic requirements, as well as numerous technical requirements about the facilities and organizations, were enacted after the National Environmental Policy Act (NEPA) became the law in 1970. Applicants for a nuclear power plant license addressed these requirements in a report of 100+ pages that became part of the environmental impact statement (EIS) for the plant. The general impression of observers was that the AEC and then NRC looked favorably on sites removed from large cities (Buchanan, 1975; Greenberg et al., 1984a-b, 1986; Price, 1968).

Local elected officials and members of the public were able to examine EIS documents after NEPA was passed in 1970. However, in this pre-internet era, the massive documents were available only in a few

places (for example, the local public library and/or city hall), and people were allowed to express their opinions in brief statements at hearings conducted by the AEC as part of the licensing process. Federal officials heard suggestions and acted on some of them. For example, officials modified their estimates of allowable population near the sites, guidelines for evacuation, and, later, when members of the public found that more than an expected number of people attracted by low taxes were moving to the host community, procedures to redistribute revenues from the utilities across the affected areas were considered (Greenberg et al., 1984a, 1986). In other words, experience suggests that the top-down process was not as rigid as it may have seemed on paper, nor was it as open as it could have been. Overall, the AEC's, and later the NRC's, processes were top-down with limited room for public participation, but even limited public input provided some opportunity for federal agencies to adapt their processes to local realities. The point of this observation is that while this modified announce-defend-build process provided somewhat enhanced opportunity for public comment, it did not permit states or communities to veto a siting decision.

b. Hazardous Facility Siting in the 21st Century: Evolution from Top-Down Processes to Processes Centering on Negotiation and Collaboration

The evolution from the announce-build approach to CBS of radioactive waste management facilities has been driven by advancements in knowledge surrounding socio-technical drivers of decision making, the increasing burden on the federal government to take over management of the growing commercial SNF inventory at reactors and orphan sites, and evidence that negotiations leading to consensus have worked in some instances.

b.i Broadening Knowledge of Decision-Making Drivers

The fact that the top-down technocratic approach was not working for siting nuclear and chemical waste facilities, as well as other locally unwanted land uses has been apparent for approaching half a century. Beginning in the 1980s, a set of widely used descriptors for public perceptions regarding the siting of hazardous facilities increasingly appeared in the literature and at public forums. These include the following:

- BANANA – build absolutely nothing anywhere near anyone;

- LULU – locally unwanted land use;
- NAIMBY – not always in my backyard;
- NIABY – not in anyone's backyard;
- NIMBY – not in my backyard;
- NIMTOO – not in my term of office;
- TISE – take it somewhere else;
- TOADS – temporarily obsolete abandoned derelict sites; and
- WESER – waste and source reduction (Greenberg, 2018).

Kasperson (2005) noted that opposition to siting of hazardous facilities is a widely shared feeling in countries across the world that leads to impasses requiring major rethinking and redirection of siting processes. Greenberg, Popper, and Truelove (2012) labeled many of these LULUs as "enduringly objectionable," that is, opposition will be ongoing into the foreseeable future, especially where the public was not provided avenues for meaningful participation in the siting process.

Kunreuther, Fitzgerald, and Aarts (1993) created a facility siting credo. The product of meetings and surveys of people involved in attempts to site hazardous facilities; the guidelines are as follows:

- "Institute a broad based participatory process;"
- "Achieve agreement that the *status quo* is unacceptable;"
- "Seek consensus;"
- "Work to develop trust;"
- "Choose the solution that best addresses the problem;"
- "Guarantee that stringent safety standards will be met;"
- "Fully address all negative aspects of the facility;"
- "Make the host community better off;"
- "Use contingent agreements;"
- "Seek acceptable sites through a volunteer process;"
- "Consider a competitive siting process;"
- "Work for geographic fairness;"
- "Set realistic timetables;" and
- "Keep multiple options open at all times."

These developments between the 1980s and early 2000s led to revised approaches for facility siting that included collaborative considerations. Figure 1 below is a simplified version of a siting process—not specific to radioactive waste management facility siting—proposed in the early 21st century that includes considerations similar to what would come to be called CBS (Greenberg, 2018). The first rectangle begins with the builder weighing activities at an existing site or trying to find a new site. Then the figure branches into two views of a siting process. On the left is the traditional profit and cost minimization objective and on the right a public responsibility entry point that involves legal, political, social, economic, environmental and health considerations in siting. The right side arguably was absent under the location science model of decision-making.

Moving down the chain, the next branches lead to three interesting considerations. On the left is the key decisionmakers' set of personal motives and knowledge. This is an important point because early locational science assumed that the decision-makers had all the information necessary and their motives were focused on organizational profit, not taking into account any personal motives (Greenhut, 1956; Simon, 1991). The right side is an alternative that centers on obligations to society, which was not part of traditional location science.

The fourth set of considerations in Figure 1 distinguishes between traditional economic siting considerations, such as costs of raw materials, transportation, and the other economic efficiency factors described earlier versus those that are now increasingly weighed; for example, making the sites less visually objectionable, acknowledging and dealing with public concerns, and embracing the role of local government representing communities and communities representing themselves. The penultimate pair of rectangles acknowledges that developers can choose among siting and non-siting options. Given the history of top-down siting in the United States, it is likely that CBS would initially be considered part of the negotiations and other non-siting options as part of the process toolbox for reducing the gap between national policy and local objectives.

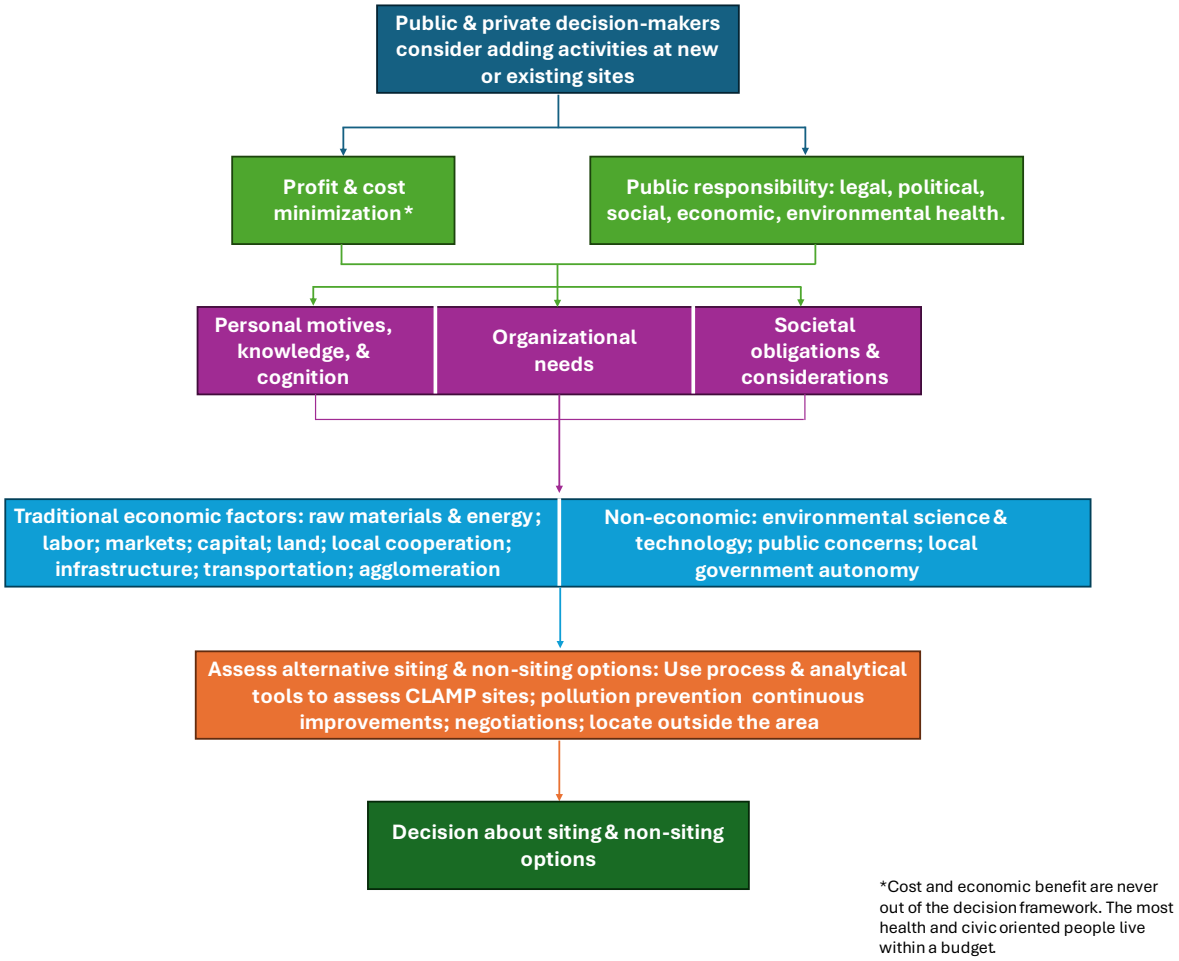

Figure 1. Increasing complexity of siting processes in the 21st century. (after Greenberg, 2018)

b.ii Increasing Burdens on DOE and NRC

Stewart and Stewart (2011), Walker (2009), Macfarlane and Ewing (2006), Richter et al. (2021), Webler and Tuler (2020), and Swift (2020) have documented the difficult challenges DOE has faced in siting facilities for managing (or disposing) of radioactive material—including storage and disposal facilities for commercial SNF. Commercial SNF currently sits at 75 sites in 34 states (Swift, 2020). DOE was made responsible for taking control of commercial SNF in January 1998 by the Nuclear Waste Policy Act (NWPA) of 1987 (NWPA, 1987); however, DOE has yet to meet its contractual obligation to take possession of commercial SNF, resulting in the payment of billions of dollars in damages[3] from the federal Judgement

[3] According to the GAO, the federal government paid almost $9 billion in damages to utilities through September 30, 2020 (GAO, 2021).

Fund (as opposed to use of the Nuclear Waste Fund) to plant owners and operators (Government Accountability Office, 2014). Here we highlight several steps that have led to CBS.[4]

A good place to start for evidence that the federal government was being advised to revisit its top-down approach to siting more generally is during the Carter Administration when the Interagency Agency Review Group (IRG), convened by the President after his decision to defer commercial SNF reprocessing (IRG, 1979), recommended that government preemption would face stiff opposition and that the federal government should focus on "consultation and concurrence" (IRG, 1979). Notably, the U.S. Congress changed the language to "consultation and cooperation." Specific to SNF management, these ideas were incorporated into the NWPA of 1982. Metlay (2013) offers several conclusions about the significance of these early endeavors, asserting that existing cooperation between the federal government and the state, as well as other levels of government, increased the chances of cooperation between all parties regarding nuclear facility siting issues.

Moving forward, some progress was made during multiple Democrat and Republican presidential administrations toward a more participatory siting process. Under President Obama, the Blue Ribbon Commission on America's Nuclear Future (BRC) was created "to conduct a comprehensive review of policies for managing the backend of the nuclear fuel cycle and recommend a new strategy" (BRC, 2012) after his decision to stop the development of a permanent deep geologic repository at Yucca Mountain. After two years of meetings, testimony and deliberation the BRC observed that:

> "*Siting storage or disposal facilities has been the most consistent and most intractable challenge for the U.S. nuclear waste management program. The erosion of trust in the federal government's nuclear waste management program has only made this challenge more difficult.*" (BRC, 2012)

The BRC recommended creating a CBS process that would be "flexible, adaptive, and responsive" as well as "open and transparent … with broad public participation" (BRC, 2012). Using Canada, Finland, and Sweden as examples of countries that were making progress, the BRC called for creating a process that was agile, not rigid, and that would be transparent and adaptable. DOE has since taken steps toward fulfilling this recommendation.

[4] Please note that we do not address the siting of low-level radioactive waste management facilities in detail as part of this report (NRC, 2020).

On December 23, 2015, DOE requested public comment on a CBS process. Public meetings were held in ten locations across the United States, and DOE produced a draft report (DOE, 2016a) of what it had learned from these public meetings. Arguably, the main messages from DOE's summary addressed public trust and the need for a process that is fair and comprehensive. On January 12, 2017, DOE issued a draft CBS process (DOE, 2017) for public comment. Since then, DOE released a revised process in 2023 (DOE, 2023a), and has funded 13 CBS Consortia (one of which produced this report).

After the conclusion of the BRC, knowledge regarding negotiations, consent, and collaboration in the context of nuclear facility siting continued to mature. Jenkins-Smith et al. (2018) surveyed over 2,000 Americans about a variety of nuclear energy and technology issues. Regarding siting facilities for managing (or disposing) of radioactive material, the public preferred permanent storage over continued on-site or interim storage of SNF and was more likely to approve of a SNF storage facility that was supported by a majority of the residents of the potential host state. Notably, 82 percent of respondents wanted local farmers and ranchers to have a voice in the final decision, and 56 percent believed such groups should have a veto; however, only 27 percent wanted the state governor to have a voice and a veto (Jenkins-Smith et al., 2018).

Another source of information was from expert groups in public participation. One notable example was the creation of an Expert and Citizen Assessment of Science and Technology (ECAST) network to use participatory technology assessment (Richter, 2021). Launched in 2010 and ended in 2017, it sought to build trust toward siting facilities for managing (or disposing) of SNF among science experts and community groups. The ECAST group, and studies by various writers from different countries, pointed to the U.S. federal government's technocratic location process as a formidable obstacle to siting (Bella et al., 1998; Bergmans et al., 2015; Blowers, 2006; Carter, 1987; Chilvers and Burgess, 2008; Cotton, 2017; Endres, 2012; Krutli et al., 2012; Shrader-Frechette, 2000; Suldovsky, 2016; Walker, 2009). ECAST identified the following as key focal points for achieving an agreement between the federal government and other parties, especially communities:

1. Ensuring that procedures and outcomes were fair;
2. Building sustainable trust through transparency and empowering communities;
3. Addressing community health and economic needs;
4. Distributing power so that each level of participant plays important roles and has the right to withdraw from the process; and
5. Designing the process to be adaptable to change.

c. Socio-Technical Themes for CBS

Overall, DOE faces challenges in its efforts to find a site(s) where SNF can be managed. Some of the challenges are technical and economic, while many are socio-technical and require building public confidence in the process. As summarized below, and discussed more fully in the remainder of this BoK, some of the most critical socio-technical themes to consider in a CBS process include cooperation amongst parties, the definition of consensus, and the need to build enduring trust relationships with communities surrounding a proposed site.

c.i Cooperation and Consensus

Before establishing an agreement between DOE and a community(ies), the parties need to be willing to cooperate. Each party has to believe that it will benefit from listening to each other and negotiating differences to reach an agreement. The DOE has to believe that their chances of building, licensing, operating, and eventually closing one or more facilities will increase with community agreement. The communities have to trust that the DOE will deliver on promises that may include jobs, taxes, infrastructure, and whatever else is negotiated as part of an agreement.

One emerging theme from early meetings of the CBS Consortia is that the definition of "consent," and the process of reaching consensus, is likely to be community-specific and has important reference points in various applications. Webler and Tuler (2020) summarized the application of the concept in medical procedures/treatment, research, international development, and political theory (see also Taebi and Roeser (2015)). In the medical professions, for example, consent is critical to protect the patient (or a stand-in for the patient if the patient is unable to give consent) and the medical practitioner. A core part of the medical practice requirement is to explain the procedures, emphasizing risks, before proceeding. By providing a reasonable amount of detail, the practitioner is protected from the charge that s/he did not provide accurate and/or sufficient information to the person or group that has to consent. Yet, even in the medical practice case, there are serious issues about the quality and quantity of information presented to patients (Resnick, 2021; Sreenivasan, 2021). How much information is necessary and how that information should be communicated are not simple questions to answer. Another useful reference point is the definition of consent developed by Planned Parenthood (Planned Parenthood, 2024) and commonly referred to as "FRIES"—consent must be **f**reely given, **r**eversible, **i**nformed, **e**nthusiastic, and **s**pecific—

which may feature commonalities with the use of the term in the context of siting a federal Consolidated Interim Storage Facility (CISF).

A conundrum related to hazardous facility siting and especially relevant when examining past attempts to site a federal CISF (or its past equivalents) is *who is granted decision-making power*? Will there be a single negotiator for each party, multiple participants for each, or is a referendum of local stakeholders necessary? Should decision-making power be given only to the community being considered, or should it extend to surrounding communities and even the state as a whole? These complexities suggest that responsibilities of the organizations seeking to build consensus and potential host communities need to be as unambiguous as possible. Neither of these decisions is easy for the grantee because the grantee may be represented by a large number of people, some of whom are deeply involved in the process and knowledgeable about the issues, while others are not.

The involvement of multiple people and parties in future siting decisions also motivates the question *what type of agreement is needed*? Conceptually, agreement may be given in writing or verbally; however, a show of hands, a nod, or silence in response to a proposal is problematic when there are many parties. We note that international law has specific requirements for obtaining consent between states (Lister, 2010). In the case of a federal CISF, the DOE's representatives may be negotiating with Tribal Nations, which implies dealing with special rights not granted to states and local governments (Webler and Tuler, 2020).

However, all hope is not lost. The literature offers examples of successful outcomes in achieving consensus:

- The Environmental Protection Agency (EPA) has often faced considerable opposition to its rulemaking processes and thus assessed negotiation as an alternative to rulemaking. Schneider & Tohn (1985) report that face-to-face negotiations were more successful when: 1) a consensus decision-making process was used; 2) a facilitator led the negotiations; and 3) the parties agreed to who could participate in the negotiations (see also Porter (1988)).
- Land use decisions are another long-standing hotly contested arena (Susskind, et al., 1999)—though negotiations sometimes leading to agreements among disagreeing parties are routine in environmental-related issues. A great deal of impetus for negotiated dispute resolution was built during the last two decades of the last century, leading to improved processes and principles for negotiations, agreement, and granting consent (Amy, 1983; Bingham, 1986; Carpenter, 1988; Cormick, 1908; Fisher & Ury, 1981; Lamb, 1990; Porter, 1988).

- Farmers vs. local governments is a common source of dispute, often leading to violence. On this subject, Hoefsloot and van den Berg (1998) examined six local examples on four continents concerning the difficult challenge of maintaining economically viable farms and reducing their environmental impacts. The authors report that the participants agreed that the efforts were successful. They pointed to the following conditions as contributing to successful negotiations (in order of their presentation in the report):
    - Agreeing about the issues that should be examined;
    - Allowing sufficient time for negotiations;
    - Providing financial support for the process and implementing solutions;
    - Agreeing who could and could not participate;
    - Agreeing what geographical areas should be included;
    - Allowing participants not to participate in every part of the process;
    - Recognizing that participants come with different levels of formal education, knowledge, and perspectives about the subject; and
    - Recognizing the importance of skilled, neutral mediators.
- Other studies find many of these same attributes. Giacalone et. al (2017) studied what were called "controversial" projects: 1) Hudson River superfund site, which resulted from contamination of the Hudson river with polychlorinated biphenyl (PCB)-laden waste; 2) Cape Wind Massachusetts wind farm proposal in the Nantucket Sound; 3) Moab uranium mill tailings remediation act site in Grand County Utah; 4) Boardman to Hemingway transmission line proposed to run from Oregon to Idaho; and 5) Warren County PCB landfill (McGurty, 2007). These sites are quite different regarding type of waste, location, who was responsible for addressing them, and other influences. Giacalone et. al (2017) accumulated 11 lessons learned that point in four directions: 1) understanding different definitions of consent, 2) encouraging active public engagement, 3) building trust; and 4) making it clear that the process is fair, and the community's well-being is central.
- While this Body of Knowledge (BoK) is focused on the U.S., international perspective can be valuable. Metlay (2013) examined processes in Sweden, Finland, France, United Kingdom, Canada, Japan, Switzerland, and Germany. These countries are similar to the U.S., insofar that they are relatively affluent, have democratically elected governments, and are members of the Organization for Economic Cooperation and Development (OECD). Metlay (2013) points to the need for a power sharing process. Another important point observed across these nations was the

need for the federal government to build a strong technical and persuasive argument to present to state, regional, and local governments.

- Sometimes the best of intentions fail, or at first appear to fail. During the 1980s, New Jersey made a concerted effort to estimate the need for hazardous waste facilities. It was one of the first states to do so, creating a plan that included estimating the volume and types of waste, and then converting these into numbers of needed incinerators and landfills. The plan was released in 1985 (Lanard, 1983; Dodd, 1986). The plan was supposed to attract volunteer municipalities. After much effort, some local governments expressed interest but withdrew. Instead, the state's businesses coped by turning to source reduction, recycling, recovery, treatment, and, in some cases, the waste was shipped out of state. Arguably, the failure to find volunteer communities pushed business and government to find alternative process and address legal questions.

c.ii The Importance of Creating and Sustaining Trust

One of the DOE's latest CBS documents (DOE, 2023a) speaks directly or indirectly to the elements of successful cooperative programs. This April 2023 DOE document reiterates the need for facilities to accommodate the growing amount of SNF and thereby reduce the amount of storage at 75 nuclear power sites. In the past, the lack of such a nationally implemented plan was a factor in16 states placing moratoriums on new nuclear power plants (DOE, 2023a). One clear change from the 2017 plan (DOE, 2017) is to put more emphasis on one or more federal CISF sites rather than on a permanent deep geologic repository. The report points to the need to build trust between the DOE and communities and emphasizes that communities have the right to withdraw from the process, which some of the literature on CBS does not include. The report also speaks to an opportunity for local communities to suggest siting criteria, which is a remarkable change from the days of location science and technocratic-centered processes. It also emphasizes the use of federal financial support for communities. The overall impression from the April 2023 revised CBS document is that the DOE anticipates being flexible in its responses to community concerns (see also American Nuclear Society (2023)). These ideas are also articulated in DOE's 2023 handbook for its CBS Consortia (DOE, 2023b) and in a DOE-published report on engaging with Indigenous communities (DOE, 2021). The last of these publications includes the following important perspective about building trust:

> "*Trust is built over time. It is important not to take it personally as trusting is not always immediate – it is a process that occurs in steps.*" (DOE, 2021)

Beginning in the late 1980s, scholars from multiple nations expressed their concerns about declining trust in institutions and the impact of declining trust on society, especially its democracies (see also Elster (1989); Etzioni (1996); Fukayama (1995); Hardin (1992); Misztal (1996); Putnam (1993); Seligman (1997); Warren (2010))—motivating thorough consideration of trust as part of efforts to achieve CBS of a federal CISF. According to Uslaner (2002):

> "*Trust is the chicken soup of social life. It brings us all sorts of good things– from a willingness to get involved in our communities to higher rates of economic growth and, ultimately, to satisfaction with government performance.*" (Uslaner, 2002)

Three ingredients in this "chicken soup" of trust have emerged from our review of empirical research: 1) competence; 2) communications; and 3) values (Connelly et al., 2018; Earle, 2010; Cvetkovich & Earle, 1995; Lee, 2004; Poortinga & Pidgeon, 2003, 2004, 2005).

In regard to competence-based trust, the public expects professionals to be educated in their disciplines and to be aware of changes. In the case of nuclear power reactors, for example, control room operators are required to practice on mock-ups of their reactor in order to learn about changes in technology and rules and learn how to respond to possible safety threats.

Communications-based trust has become an increasingly important element of trust in recent years in light of the various forums and streams for technical communication that have emerged over the past few decades. Technically competent practitioners increasingly must be able to communicate their expertise to nonexperts, including local reporters, to adults at local meetings and to children at schools, and be prepared to respond to questions posted on the internet. Failure to communicate at acceptable intervals, without using jargon, leads to criticism and loss of trust from residents. Experts lose some of their support when they are perceived as being conceited, arrogant, or snooty, among other labels of distrust (Burger et al, 2022a; Chandra et al., 2004).

Values are a third part of trust. A good site may be opposed by community members who believe that their values have been violated by those who are greedy, dishonest, unfair, and in other ways unethical. Correspondingly, values-based trust is often tied to fairness. For example, community members in the City of Chester, Pennsylvania adamantly opposed the siting of an infectious waste incineration facility, and they sued the State of Pennsylvania under Title VI of the Civil Rights Act of 1964 arguing that the siting was unfair. The community held that the small city already had many locally unwanted land uses (LULUs) and the proposed facility would compound cumulative risk in the area. U.S. EPA documents (EPA, 2015) and

studies by a local law firm were used to support their opposition—their case was supported by a federal appeals court judge, and reached the U.S. Supreme Court, but became moot when the applicant withdrew the permit request. Prior to that siting case, a permit had been granted for a county waste incinerator, which has been opposed by the community since it was opened in 1992. The area has a nearby county sewage treatment plant, a power plant and numerous other LULUs (Cooper, 2021; Greenberg & Schneider, 1996; Sullivan, 2017). The permit for the incinerator was up for renewal in 2021 and was once again opposed by community groups on the basis of being an unfair increase in the cumulative risk—in a community that was more than three-fourths African American, among the poorest small cities in the United States, and marked by high morbidity and mortality rates.

Trust can change and sometimes will rebound but not always. People with strong views typically believe evidence that is consistent with their beliefs (Poortinga & Pidgeon, 2004). Those without pre-existing strong views are more likely to change their views. Bad news dominates the media, and hence trust is easily lost, and those organizations and professions in the same or similar areas often suffer a loss of trust by association. For example, the Consortium for Risk Evaluation with Stakeholder Participation (CRESP) was in the process of conducting surveys for DOE at the Hanford (WA), Idaho National Laboratory (ID), Savannah River (SC), and the Waste Isolation Pilot Plant (NM) when the Fukushima-Daiichi events occurred. Six questions inquired about communications-based trust, competence-based trust, and values-based trust. Prior to the Fukushima-Daiichi nuclear site failures, a survey found that 65-76% of the 1,400 respondents who living within 50 miles of the sites “strongly agreed” or “agreed” that the DOE and its contractors were trustworthy. Then the events occurred. Four months later, competence based trust fell about 10 points, and the other forms of trust fell by about five percent. In 2013, trust rebounded back to 2010 levels or higher, partly attributed to NRC’s response to the Fukushima-Daiichi accident, partly we believe because of the NRC’s actions to incorporate insights gained by evaluating the causes for the Fukushima accidents (Greenberg et al., 2014; Greenberg & Lowrie, 2023; Jenkins-Smith et al., 2018).

Trust-related challenges have been observed for climate issues, the COVID-19 pandemic, the Ebola virus, electro-magnetic fields, genetically modification of organisms, offshore gas and oil drilling, mining, urban development, and with other risk-related threats, and 9/11 terrorist attacks (Conchie & Donald, 2006; Cox et al., 2006; Leiserowitz, 2005; O’Dea & Finn, 2001; Siegrist et al., 2003; Henderson et al., 2020; Blair et al., 2017; Salim et al., 2017; Gutmann et al., 2020). Unfortunately, most of these surveys do not have pre-, during and post-event samples documented. Hence, it has not been easy to monitor changes in trust and policy implications. An exception is surveys collected by Bisconti Inc. (2023) for the Nuclear Energy Institute

since 1998. The last few years show that almost three quarters of adult U.S. residents favor using nuclear energy and about the same proportion favor building new plants. Regarding trust, the survey asked several interesting questions. Only 43 percent said that they knew how often the NRC monitored each plant, and less than 10 percent knew that it was every day. Once given the correct answer, both men and women were more supportive of nuclear energy with the men increasing from 72 to 81 percent and women from 44 to 68 percent in these surveys.

In 2013, one author of this section asked a senior DOE official (now retired) for an example of collaborative decision-making involving the DOE, state and local governments, and community groups that was successful both in community engagement and saved the federal government time and dollars. The unequivocal answer was the environmental remediation project at Fernald. The issue was to remediate a former uranium manufacturing site, close it, and implement a sustainable waste management system. The Fernald example, discussed further in Chapter 2, underscores the observations that collaboration takes time, and forthright negotiations are at the heart of processes that have a chance to succeed. Related to the siting of a federal CISF, DOE's commitment to CBS at the start is a clear message that the agency understands that it is willing to take the time required to negotiate with communities, local, and state government.

Chapter 1: Introduction

1.1 Background and Motivation

The U.S. Department of Energy (DOE) and its predecessors have a long history with processes, methodologies, and communication frameworks that they have used while making siting decisions for hazardous and radioactive waste storage, treatment, and disposal facilities (henceforth referred to as waste management facilities). In addition to DOE's responsibility for managing defense wastes, the Nuclear Waste Policy Act (NWPA) (Nuclear Waste Policy Act of 1982, as amended) conferred the responsibility of long-term management of commercial spent nuclear fuel (SNF) on DOE. The DOE's long-term planning for siting and constructing a deep geologic repository for commercial SNF is made more challenging by a growing inventory of SNF at operating commercial reactors and at orphan waste sites. This inventory has the potential to challenge existing and proposed storage capacities and impact public perceptions of the federal organizations responsible for managing this waste. An alternative to this current, site-specific, decentralized approach to SNF storage recommended by the President's Blue Ribbon Commission (BRC) on America's Nuclear Future (BRC, 2012) is the development of a federal consolidated interim storage facility (CISF) for interim management of SNF. However, as decades of experience indicate, siting hazardous waste management facilities, such as a CISF, is a daunting task. The decision-making processes rightfully incur scrutiny from local communities, state governments, other stakeholders[5] and Tribal communities concerned with potential multi-generational sociopolitical, economic, ethical, and environment, safety and health (ES&H) impacts of a CISF.

In the past, DOE, and most commercial and governmental agencies, focused on choosing radioactive and hazardous waste management sites based on the results of technical and economic analyses.[6] These choices were then justified to stakeholders and Tribal Nations[7] by communicating the means in which

[5] Drawing on the International Organization for Standardization definition, we define a stakeholder within this report as "a party having a right, share, claim, or interest in" (International Organization for Standardization, 2015) the siting of a facility for managing (or disposing) of radioactive material. This includes private citizens, local and state elected officials, non-governmental organizations, members of advisory boards, and others. Tribal Nations are interested parties in the CBS process for a federal CISF but are referred to distinctly within this report to respect their preferences and status as sovereign nations.

[6] Refer to the Preface to this report for additional information.

[7] According to Younging (2018), "The process of decolonizing language surrounding Indigenous Peoples is not finished; terms, names, and styles continue to evolve." We have chosen to use the term "Tribal Nations" in this report to respect the sovereignty of the Indigenous Peoples in the United States. However, we recognize that as the

proposed facility designs met the ES&H requirements set forth by the applicable regulators, and using negotiation tools (e.g., compensation) to supplement this approach to gain public approval when necessary. However, this approach to facility siting does not address many of the technical, social, economic, and political factors that influence stakeholder trust (Greenberg, 2014) regarding the safety and desirability of a site or in the siting process. In a CBS process, the degree to which these influences are addressed, including the need to demonstrate the fairness of the siting process, the recognition of civil liberties, the role of free and informed consent, and the consideration of state, Tribal, and local concerns (Kasperson, 2014), impact the likelihood of reaching agreement with host and adjacent communities. Further, such decisions are subject to the perceptions and concerns of all interested and affected parties, as well as local communities. Recognizing the limitations of past waste management siting decision and risk communication processes, along with recommendations by independent reviewers, external committees (e.g., BRC (2012)), and Tribal Nations, DOE is now pursuing collaboration-based approaches to siting facilities for managing (or disposing) of radioactive material that emphasize community engagement. DOE's near-term focus is on using a collaboration-based approach to site one or more CISFs.

CBS of hazardous facilities is a complex process, requiring the party or parties looking to site a facility to employ a number of processes including: seeking volunteer communities with a vested interest in the outcome; working toward developing their trust and ensuring their broad participation in all reviews and decisions; screening locations for acceptable physical characteristics; assuring that all applicable eco-cultural and environmental protection and safety standards will be employed; and seeking consensus from community volunteers and local, state, and Tribal officials; and evaluation of intergenerational concerns (Greenberg, 2018; Kunreuther et al., 1996). A CBS process intending to build and sustain trust cannot and should not be rushed. Siting a federal CISF, or other facilities for managing (or disposing) of radioactive material, in a manner that achieves open, informed, and ongoing stakeholder and Tribal collaboration requires integrating all of these processes, as well as addressing negative public perceptions and fears of ionizing radiation, historical failures in the siting of waste management facilities, and the apparent generalized distrust that plagues all levels of government at present (intensified by public concerns about the risks of nuclear materials (Greenberg, 2018)).

Thus, fundamental to the future success of CBS is the need to encourage and build trust, and to address the concerns of community stakeholders and Tribal Nations. Research has also shown that the public's

BoK continues to evolve, this terminology may need to be updated to reflect the most recent language advancements.

perception of risk drives the level of public concern for a project (Greenberg, 2018). Therefore, an important early element of achieving the ultimate goal of CBS of a CISF is learning how to improve trust and best engage with stakeholders and Tribal Nations regarding the actual and perceived risks associated with hosting a facility for management (or disposal) of radioactive material. As described above, traditional siting and risk communication approaches do not consider all of the factors necessary for achieving trust and building consensus. A need exists to enhance stakeholder and Tribal engagement in siting processes by replacing protocols that overemphasize speaking and underemphasize listening and negotiating. Rather, CBS processes need to move toward the development of adaptive frameworks and methodologies that support and indeed encourage stakeholder and Tribal participation in risk-informed decision-making, including avenues for considering social and economic impacts and possible tradeoffs.

In June of 2023, the DOE awarded the Consortium for Risk Evaluation with Stakeholder Participation (CRESP), led by Vanderbilt University, one of 12[8] awards (DOE, 2025) to help DOE develop a CBS process[9] in support of ultimately siting a federal CISF for SNF (henceforth referred to as a "federal CISF"). These 12 awardees make up DOE's CBS Consortia and are tasked with "support[ing] the U.S. Department of Energy's efforts to facilitate…community engagement and elicit public feedback on CBS, management of spent nuclear fuel, and federal consolidated interim storage"[9] (DOE, 2025). *At this time, neither DOE, nor the CBS Consortia, are searching for potentially interested host communities for a federal CISF*—the Consortia are intended to help DOE perform Phase 1B (Building Capacity) of the CBS process, with the ultimate goal of informing DOE's refinement of this process (DOE, 2023a).

Although soliciting interested communities in the future is critical to successful CBS, the aim of this document, referred to as a Body of Knowledge (BoK), is a critical preceding step to this process. This BoK is initially intended to be a library of documents for the Consortia to reference on subjects related to CBS, including: lessons learned from past stakeholder and Tribal engagements, trust building, and risk communication processes utilized in previous successful and unsuccessful siting attempts; communication and community engagement best practices documented in the literature; participatory decision-making methods, tools, and frameworks; and the role of justice, fairness, consensus, and negotiations/compensation in siting decision-making. It is our hope that this document can be used to

[8] A thirteenth Consortium, the Tribal Collaboration Consortium, was added after the fact by the DOE to give federally recognized Tribes a direct and meaningful format to contribute to the CBS process.
[9] More information regarding DOE's CBS process can be found at DOE (2025b).

inform the development and testing of the methods and frameworks used by the Consortia to support community engagement—and, later, support DOE when the time comes for siting decision-making.

1.2 Purpose and Applicability

The focus of the CRESP project is to engage communities surrounding DOE sites that are currently storing defense- and research-related SNF (specifically in the South Carolina/Georgia and Pacific Northwest regions) to foster mutual learning on best and worst practices in community and Tribal participation in risk-informed decision-making, and, based on this learning, develop and test innovative forms of community participation that builds sustainable trust among the parties. However, prior to engaging with communities, CRESP has committed to developing a BoK that discusses the specific background and subject matter related to CBS, including identification of needed areas of enhancement in trust between DOE and the communities surrounding its sites, risk communication, and tools in practice for decision-making (e.g., multi-criteria decision-making methods and associated variants), as described in Table 1. This BoK is intended to satisfy the corresponding project milestone—Milestone 1.

Table 1. Milestones and deliverables for CRESP's CBS project.

Milestone No.	**Milestone Description**	**Associated Deliverable No.**	**Associated Deliverable Description**
M1	Compilation of a BoK on needed improvements in trust, risk communication, and participation in risk-informed decision-making	D1	Presentation to the quarterly Consortia, and subsequent report documenting BoK
M2	(a) Initial stakeholder and Tribal engagements and (b) completion of demographic mapping and social media sentiment analysis in communities in geographic regions of interest	D2	Report summarizing (a) development and implementation of processes and strategies used for engagement and (b) insights gained

Milestone No.	Milestone Description	Associated Deliverable No.	Associated Deliverable Description
M3	Development/testing of approaches to support community-informed decision-making and mutual understanding of risk between communities and technical experts	D3	Report summarizing (a) development and implementation of processes and strategies used for engagement and (b) insights gained

1.2.1 Purpose

In developing this deliverable, CRESP understands the importance of fostering a consistent understanding of the concept of a "body of knowledge" between both the authors and users of this document. We adopt the definition of a BoK described in Electric Power Research Institute (EPRI) (2018):

> *"A "body of knowledge" (BoK) is a manageably-sized collection of specifically selected references that has been developed and employed by professional groups to promote education and common understanding of a particular subject area, practice, or discipline…The BoK generally takes the form of a curated collection of document citations accompanied by brief descriptions and relevant notes about the use of each document. A BoK is a guide to a library of documents, not the library itself, providing just enough information about each document to convey a sense of its content and purpose relative to the BoK domain"* (EPRI, 2018).

The primary purpose of this BoK is to comprehensively identify, summarize, and share the state of knowledge (including best and worst practices) documented within recent literature that captures experiences and lessons learned regarding the concepts of trust, risk communication, risk-informed decision-making tools and frameworks, and compensation—as they might pertain to CBS.

To accomplish this purpose, this report is organized as follows. The Preface to this report provides a brief history of the traditional hazardous facility siting process that has resulted in the need to institute a CBS process within the United States—this Preface is provided for a reader who may desire an introduction or a re-introduction to the subject matter at hand. Chapter 2 presents detailed treatment of select case studies on hazardous facility siting relevant to the concept of CBS. Chapter 3 provides a summary of the

methodology used to develop the BoK. Chapters 4-9 present the preliminary BoK that captures experiences, lessons learned, and best practices regarding the concepts of risk communication (Chapter 4); participatory decision-making methods, tools, and frameworks (Chapter 5); reflections on the ethics of facility siting described within the literature (Chapter 6); the role of negotiations and compensation as they pertain to CBS (Chapter 7); a summary of international experience in radioactive waste management facility siting (Chapter 8); and best practices and recommendations for engaging specifically with Tribal Nations (Chapter 9). Chapter 10 provides conclusions and observations/recommendations for future research in subjects related to CBS.

The text was written with two distinct formats. Our original plan was to follow the same format in every chapter. However, as we examined the literature, we found that, with one exception, an essay format was more suitable for the case studies presented in Chapter 2. Beginning with the last section of Chapter 2 and continuing into Chapters 4-9, readers will see the application of a standardized format that is suitable to summarizing a large set of articles rather than a single or limited number of cases.

1.2.2 Applicability

The BoK has been developed as a resource for DOE and the Consortia that is applicable to Phase 1B of the DOE process. Thus, the BoK is intended to provide insights on subjects that inform the development of a process to be used to site facilities for managing (or disposing) of radioactive material—and first, a federal CISF—using collaborative means.

1.2.3 Limits of Applicability

The subject matter of the BoK has been tailored to address the most important themes regarding CBS (as determined by the CRESP team) within the timeline and resource limitations that exist for the project. Correspondingly, limits exist regarding the applicability of the BoK. These limits of applicability, which are categorized as temporal-, industry-, geographic-, and data-related limits, are described below.

1.2.3.1 Temporal Limits of Applicability

Although a brief history of hazardous and nuclear facility siting is provided in the historical preface and Chapters 2, the primary focus of the BoK is on books, journal articles, reports, conference proceedings, etc. that have been published since 2012—when the BRC published their final report. President Obama created the BRC in 2010 to "provide advice, evaluate alternatives, and make recommendations" for "a new plan" to manage the back end of the fuel cycle in the U.S. One of the BRC's primary findings was that new approaches were needed to site and develop facilities for managing (or disposing) of radioactive material in the future (BRC, 2012). It recommended that these approaches be adaptive, staged, and collaborative such that "affected communities have an opportunity to decide whether to accept proposed new sites and retain significant local control" (BRC, 2012). The BRC also recommended siting one or more CISFs, using a CBS strategy, for interim management of SNF.

In developing these recommendations, the BRC put a great deal of effort into (1) commissioning studies and (2) accepting for the record additional studies done on the nation's nuclear program—including 29 commissioned papers, 86 research documents—many on subjects relevant to CBS efforts today.[10] We have thus limited the BoK primarily to coverage of documents produced since this time.

1.2.3.2 Industry Limits of Applicability

Many industries, beyond the nuclear industry alone, have faced contentious siting processes for facilities the public deems hazardous or detrimental to the community—these include energy facilities (both "clean" energy facilities such as windfarms and solar farms, as well as oil and natural gas facilities), chemical process facilities, infrastructure facilities, etc. A select set of case studies describing these experiences have been included within Chapter 2. These case studies have been selected at CRESP's discretion—based on their relevance to the primary subjects of the BoK. Because of siting challenges, many of these industries have been examining roles and processes for public participation in facility siting. Our initial focus industries for the BoK are limited to energy facilities, hazardous facilities on existing DOE sites, and other radioactive waste management facilities—all of which have been active areas of research within the temporal limits of the BoK.

[10] The University of North Texas has archived the BRC's website, where these documents and reports can be found.

1.2.3.3 Geographic Limits of Applicability

Radioactive waste management facility siting is a topic of interest globally due to the prevalence of commercial nuclear power. The focus of the BoK is on publications describing siting efforts in the United States, since experts (Tuler & Kasperson, 2010) have questioned the applicability of lessons learned from international efforts due to political, social, technical, and geospatial differences between such countries and the United States. However, select international works from countries who have employed or are employing similar processes (e.g., Finland, Sweden, Canada, etc.) deemed to contain particularly relevant or new information for the audiences of the BoK have been summarized in Chapter 8.

1.2.3.4 Data Limits of Applicability

Since it is our intention that this BoK be distributed to the CBS Consortia and be stored on the publicly accessible CRESP website, only publicly available references and data sets have been used in its creation.

1.3 Document Use and Retention

Internally, CRESP intends to use the BoK as a supplement to the project team's experiential knowledge to help complete Milestones 2 and 3 (described in Table 1 above) of the CBS project. For Milestone 2, the BoK is intended to help the CRESP team better understand DOE's relationship and history with the communities and groups surrounding DOE sites and to document best (and worst) practices in risk communication—so that CRESP can use the information to inform the strategies used to engage with the individuals and communities within the regions of geographical interest for the project. Further, the BoK is intended to summarize the state of knowledge in risk-informed decision-making methods—so that CRESP can demonstrate and assess state-of-the-art methods as part of the community-led decision-making research performed to accomplish Milestone 3.

However, in addition to CRESP's specific Workscope, each awardee within the Consortia has been tasked with community and stakeholder engagement and the development of strategies to support mutual learning. The BoK is intended to be useful to DOE's CBS Consortia and others participating in DOE's CBS endeavors to help establish a common basis among the Consortia on the subjects described in Section 1.1 above. Thus, the key results of this report have been shared at the quarterly CBS Consortia meetings, and a final copy of the report will be shared with DOE and the awardees.

It is intended that the BoK be a participatory document that reflects the viewpoints of those communities with ties to developing the process used for CBS, and its initial demonstration in the U.S. for siting a federal CISF. Correspondingly, CRESP also envisions the BoK itself as a tool to be used to support stakeholder and Tribal engagements as part of the Consortia work and beyond. For example, the BoK could be used to elicit stakeholder and Tribal feedback regarding its subject coverage—where documents have been left out, or where insufficient emphasis has been placed on a given subject. In later stages of the DOE process, the BoK may be used as an educational resource for communities considering whether to pursue hosting a federal CISF.

This report documenting the BoK is intended to be a living document which CRESP will maintain throughout the duration of the project. CRESP intends to store and archive this report consistent with internal best practices and retains the responsibility to update the BoK if and when the project team determines it to be a necessary and value-added evolution, e.g., in the case that stakeholder and Tribal feedback reveals gaps or opportunities for expansion.

Chapter 2: Select Case Studies

written by Henry Mayer and Michael Greenberg

2.1 Background

Before delving into the contents of the BoK, it is important to understand the context within which DOE's CBS process is situated today. This includes the general historical context within which the process takes place but also includes an understanding of recent hazardous facility and nuclear-specific siting evolutions, which are summarized in the remainder of this chapter. The case studies described in this chapter add to DOE's evaluations of domestic best practices in the wind, petrochemical manufacturing, and mining sectors highlighted in Leslie (2024).[11] However, we note that the purpose of this chapter is not to present a comprehensive examination of all previous siting cases with relevance to DOE's ongoing CBS efforts, for this would be the subject of a book on its own (or even multiple volumes). Rather this chapter presents six recent[12] case studies—based on the authors' expert opinions—that are important to reflect upon when considering CBS today. These case studies are as follows.

- Section 2.2: Provides a summary of the experiences and outcomes of the Monitored Retrievable Storage (MRS) project led by the Office of the Nuclear Waste Negotiator.
- Section 2.3: Provides a description of the commercial SNF MRS facility siting attempt by Private Fuel Storage, LLC and the Skull Valley Band of Goshute Indians in Utah, including the legal means used to block the construction of an MRS at the licensed site.
- Section 2.4: Provides a description of the impacts that concerned citizens groups (specifically Mothers for Nuclear) can have on the nuclear facility licensing process.
- Section 2.5: Discusses the use of transportation as an element of the negotiations package that led to the successful siting of the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NV.
- Section 2.6: Describes how the use of participatory decision-making at Fernald through the use of citizens advisory boards and charrettes that allowed participants to formulate and test their ideas

[11] Leslie (2024) describes that the Nuclear Waste Technical Review Board (NWTRB) emphasized the importance of releasing these lessons learned reports publicly (and to the CBS Consortia); however, to the best of the authors' knowledge, these case studies have not been publicly released or published on the CBS Consortia resource library homepage.

[12] As described in Section 1.2.3.1, the emphasis of the BoK is on activities that have occurred since the publication of the BRC final report in 2012; however, some case studies and references prior to 2012 are included due to their perceived importance by the authors of the BoK.

and helped build and increase trust, leading to consensus decision-making and satisfactory cleanup of the site.

- Section 2.7: Conveys how non-nuclear facilities can also be subject to siting controversies. More specifically, Section 2.7 describes issues that have recently emerged during natural gas, wind, and solar facility siting.

2.2 Previous Voluntary Local Siting Experiences and Outcomes

The Nuclear Waste Policy Amendments Act of 1987 established the federal Office of the Nuclear Waste Negotiator (ONWN). The ONWN was to attempt to find a state or Tribal Nation willing to host a federal MRS facility for the temporary storage of SNF generated by commercial power plants. The availability of $100,000 in federal funds to local/state government organizations and Tribal Nations to independently research and understand the nuclear waste management system was the primary tool used to entice states and Tribal Nations to take the first step. Longer term, Congress authorized, as a baseline, the host state or Tribal nation to receive $5 million per year prior to the shipment of waste and $10 million per year during the operational phase of the MRS facility. States were required to transfer no less than one-third of the financial benefits to nearby local governments. Those having an interest in pursuing the program after their initial research could apply for grants of as much as $3 million or more for additional studies, but these Phase II grants required approval from the State Governor or the Chief Executive of an Tribal Nation. (Kassan, 1993; Ou, 1995)

As of February 1993, a total of 29 organizations had applied for or indicated strong interest in applying for a Phase I and/or Phase II MRS Grant. Of these, three were rejected by the ONWN for various reasons, leaving five county governments and 21 Tribal Nations. Of these, four Tribal Nations, whose applications for a Phase I grant were approved, withdrew from the process before the funds were issued and eight others dropped out of the process. The remaining nine Tribal Nations applied for Phase II-A grants, and four were approved. Objections by State Governors and widespread public opposition prevented the five counties from moving forward in the process. (Public Citizen, 2005)

In this case study, we briefly examine the experiences of three county governments and one Tribal Nation in Iowa, Wyoming, Utah, and New Mexico who expressed interest in possibly being a host of an MRS facility and the outcome of their efforts.

2.2.1 San Juan County, Utah

San Juan County, Utah, was one of the county governments awarded a Phase I grant to research and understand the nuclear waste management system and specifically the storage of SNF. The county is located in the southeastern portion of Utah encompassing an area of 7,933 square miles. It had a population 14,518, made of equal 49% proportions of white and Tribal Nation residents as of the 2020 U.S. Census. The Navajo Nation lands are located in the lower quarter section of the county and extend into Arizona and New Mexico. “In 1993, San Juan was one of Utah's most economically distressed counties. In 1991, the unemployment rate was 9.2 percent, almost twice the state average, and the average wage was $15,912, about 70 percent of the state average” (Utah, 1993). San Juan County is defined as a “persistent poverty” community by the U.S. Census Bureau, which means that at least 20% of the population has been defined as having been poor for at least thirty years.

Calvin Black, Chairperson of the San Juan County Board of Commissioners (Board) championed the opportunity to explore ways to improve the county’s economic condition. The Board used its $100,000 grant to identify a broad range of issues concerning both the MRS facility and a possible Phase II feasibility study. They hired consultants who invited questions, comments, and ideas from the public in a variety of forums, including private interviews, community meetings, open public forums, a newsletter/survey, and a toll-free phone number. They reached about 800 residents, as well as state-level agencies and interest groups. The issue most often raised was ES&H risks to the people, animals, and environment (particularly water) of the county and surrounding areas associated with the storage of SNF. There was also a great deal of concern about risks surrounding transportation of SNF. Comments and suggestions were raised about the public’s involvement in the proposed feasibility study should the MRS effort continue. Locals also expressed the need for information from impartial sources, with the goal of receiving clear, honest, and complete information. The public also had much to say about the credibility of government at all levels, especially at the federal level. Many felt the government's record of honesty about health risks relating to current and past mining, milling, and nuclear testing was seriously flawed in San Juan County (Utah, 1993).

The results of the Phase I study indicated that most residents who did express themselves were not interested in learning more about the issues. “Approximately 80 percent, in the consultant’s opinion, of those citizens already had a firm position on the MRS facility, it would be an economic benefit and pose no significant health risk, or it would not be the answer to the county's economic woes and it would bring intolerable health risks. Approximately twenty percent remain undecided about the wisdom of siting” (Utah, 1993).

On January 13, 1993, Governor Michael Leavitt announced his opposition to the siting of an SNF storage facility in Utah out of concern for the long-term interests of the state. This action precluded the San Juan County Board of Commissioners from pursuing a Phase II feasibility grant and thus terminated their effort. The Governor was "not willing to voluntarily bring in high-level nuclear waste from all over the country for what will likely amount to permanent storage" (Utah, 1993).

2.2.2 Mescalero Apache Tribe, New Mexico

The Mescalero Apache Tribe live on a 720 square mile reservation in South-Central New Mexico, 125 miles south of Albuquerque. At the time of the Tribe's application under the MRS grant program, it was headed by President Wendell Chino, who had been in power for over 30 years, and an elected Tribal council that served as both government and the board of directors for the Tribe's business ventures. The Tribe had developed several successful business operations, including a luxury hotel and casino, a ski resort, a golf course, a cattle ranch, and a sawmill (Sachs, 1996).

Although these business ventures helped to raise the living standards of the Tribe, the Mescalero were still a poor people. Unemployment hovered around 30 percent during the 1990s and the median household income of the New Mexico Mescalero (according to the 1990 census) was $14,364, compared to $35,225 for Americans as a whole. In 1989, 47.9 percent of the Tribe in New Mexico lived below the federal poverty level (Sachs, 1996).

The Tribe was initially attracted to the MRS program because of the Phase I grant money and because of the large influx of cash the project would bring in if completed. The Tribal leadership estimated that the Tribe would receive $250 million in direct and indirect benefits from the project over 40 years. The Tribal leadership also argued that the MRS would provide high-wage jobs to younger Tribe members, who were increasingly leaving the reservation. According to the 1990 Census, 50 percent of the Mescalero Apache in New Mexico were under 19.1 years of age. The Tribal leadership assumed that Tribal members would fill sixty percent of the jobs at the MRS, however, opponents to the proposal charged that they would get only the low-paying service jobs associated with the facility, while non-Indians would hold the high-paying technical and managerial jobs (Sachs, 1996).

The Mescalero Apache Tribe was the first organization to apply for an MRS grant, in October 1991. The Phase I funds were used to conduct a phased, preliminary study of the safety, technical, political, environmental, social, and economic feasibility of hosting an MRS. Although the conditions of the grant

did not require submittal of any report on the grantee's activities, the Tribe prepared a Feasibility Report (Mescalero Apache Tribe, 1992) on how it approached the project and how it gathered the information it used to base its current and future decisions regarding the MRS. The Tribe intended to "pursue continued study of the MRS with the following objectives: 1) continuing the comprehensive environmental, education understanding process towards a of the safety, technical, social and economic aspects of the MRS; and 2) conducting an effective public participation and information program" (Mescalero Apache Tribe, 1992). In August 1993, the Mescalero Apache Tribe applied for a $2.8 million Phase II-B grant stating that it was ready to begin "credible, formal discussions" regarding hosting the MRS facility. However, the prospect of an MRS facility in central New Mexico was unpopular among the non-Native population of the state, especially since New Mexico was already the host of another deep geologic repository, the WIPP near Carlsbad, east of the Tribal land (see Section 2.5 below).

Because state officials had no authority to intervene in the Tribe's negotiations, they sought another approach to blocking them from pursuing an MRS facility. Senator Jeff Bingaman (D-NM) sponsored legislation at the federal level that would require interested Tribal Nations to gain the cooperation of state and local officials before receiving study grant funds[13] (Gowda & Easterling, 1998). When the appropriations bill went to conference, conferees went a step further and voted to bar use of the Nuclear Waste Fund for study grants. Because DOE did not receive an appropriation from general revenues for study grants, the program was effectively canceled (Sachs, 1996).

Frustrated by the delays and politics of the federal MRS project, the Mescalero Tribal council initiated direct contacts with nuclear utilities in December 1993 about possibly building a private MRS on the Mescalero reservation. Eventually, 33 utilities, led by Northern States Power of Minnesota, discussed the proposal with the Tribe during 1994. The Tribal council and the utilities drafted a Letter of Intent in December 1994, but in a January 31, 1995 referendum, the Mescalero voted 490 to 362 against further negotiations. The Tribal leadership, which supported the venture, organized a petition drive for a revote, and on March 9, 1995, the Mescalero reversed themselves and voted 593 to 372 in favor of the project (Sachs, 1996). Negotiations over the design and financing of the facility continued throughout 1995. However, by April 1996, the consortium, called the Mescalero Fuel Storage Limited Liability Corporation,

[13] Energy and Water Appropriations Act of 1994, Amendment 988: "None of the funds provided under this Act shall be made available for Phase ll-B grants to study the feasibility of siting a Monitored Retrievable Storage Facility unless the Nuclear Waste Negotiator has first certified to the Secretary of Energy that there is a reasonable likelihood that agreement can be reached among all of the relevant governmental officials in the vicinity of any proposed site."

represented only eleven utilities and unresolved legal liability, compensation, and location issues caused the talks between the two groups to be "indefinitely suspended" (Leonard III, 1996).

2.2.3 Wayne County, Iowa

Wayne County, Iowa has a total area of 527 square miles and is located along the state's southern border with Missouri. As of the 2020 census, the population was 6,502 and 95.8% non-Hispanic White. Today, Wayne is the third-poorest county in the State (U.S. Census Bureau, 2023).

The Wayne County Development Corporation (WCDC) was made aware of the MRS initiative and the related feasibility study grant program in 1992 by Dr. Daniel Bullen, a Technical Staff Member of the Defense Nuclear Facilities Safety Board who was a recent faculty addition to Iowa State University's Nuclear Engineering Department. Dr. Bullen contacted Dr. Edward Stanek, Science Advisor to the Governor in April on behalf of the WCDC and in July, John Hendren, President of the WCDC followed up with another call to Dr. Stanek. In a meeting a few days later, Dr. Stanek discusses WCDC's interest in the MRS grant program with Governor Branstad, whose initial reaction was "No" (Bullen, 2023).

The WCDC continued to discuss the MRS feasibility grant program and invited a representative of the Omaha Public Power District to make a presentation regarding SNF storage technology. WCDC formally advised the ONWN of their interest in September and Mr. Hendren spoke with Chuck Lempesis, ONWN Chief of Staff. Following the MRS grant application procedures, Mr. Lempesis made informal contact with Governor Branstad's Office. The response was that a suggested MRS discussion should wait until after the November election. In December, discussions took place between Mr. Lempesis and the Governor's staff, and on December 30th Mr. Hendren was told that the Governor would consider the MRS issue (Bullen, 2023).

On February 4, 1993, Mr. Lempesis, Mr. Hendren, and Dr. Bullen met with the Governor and his staff. Although initially very pessimistic, because of the Governor's concerns about the recent medical waste incineration issues and an expected public and political backlash, the Governor agreed to not oppose an initial MRS study. The WCDC held a public meeting two days later to present the MRS feasibility study grant program, with most of the County Supervisors indicating their support for taking this initial step to learn more. The Des Moines Register, the state's largest statewide newspaper, on February 9th summarized Wayne County's interest in the MRS Feasibility Grant Program. It noted that the Governor would not block the feasibility study, but his Press Secretary was quoted, "he wouldn't block the study, but he is not

supporting their efforts. The Governor believes the safety, social, and political issues are stacked against a decision to proceed" (Des Moines Register, 1993).

2.2.4 Fremont County, Wyoming

Fremont County is located at about the center of the State of Wyoming and encompasses an area of 9,266 square miles. It had a population 39,366 as of the 2020 U.S. Census. The Wind River Indian Reservation, home to the Eastern Shoshone and the Northern Arapaho Tribal Nations makes up about one-third of the county's land area. Unlike the several communities discussed above in this case study, Fremont County is the fifth most populated county in the state and had a median household income of $60,030 versus $70,042 for the state in 2020. Although the poverty rate for the county's 78% white population was 10.7%, it was 25.9% for American Indians and 16.7% for Hispanic people in 2022 (U.S. Census Bureau, 2022).

The Freemont County Commissioners approached Wyoming Governor Mike Sullivan in December 1991 about their interest in applying for a $100,000 MRS grant to learn more about temporary storage of SNF. The DOE required a letter of "no objection" from governors before it would consider grant applications from organizations in the state, other than Tribal nations. Governor Sullivan said that he would not object to a study of possibly building a temporary SNF storage site, and that his decision showed his recognition that the country needs to discuss alternatives to dealing with SNF. However, in his letter to the Commissioners, he noted, "You must clearly understand this action should not be interpreted as an endorsement of the MRS or its potential location in Fremont County" (Deseret News, 1991).

Fremont County received the $100,000 grant requested and used the funds to organize a Citizens Advisory Group to generate public debate and discussion of locating an MRS facility in the County. In August 1992, the Commissioners requested that the Governor support its application for a $200,000 Phase II-A grant. The Governor refused to allow the county to go further. In his letter to the Commissioners, he stated that the "state cannot expect to control the terms under which such a long-term decision would be implemented. I do not object to further education or debate, but the discussion I would seek is only tangentially related to Phase II. The process is federally engineered to avoid several basic questions that I am not convinced can be answered to the satisfaction of the people of Wyoming… Can we trust the federal government or the assurance of negotiation to protect our citizens' interests? To do so would disregard the geographical voting power in Congress and 100 years of history and experience. We have had such assurances on issues like grazing fees, federal mineral royalty administrative costs, operations of dams and

waterways, and wolves, and yet we are continually called upon to fight to retain those assurances because of a change in circumstances (fiscal or otherwise) or a change in the attitudes in Congress. Let us not deceive ourselves—we are being invited through continuing study to dance with a 900-pound gorilla…. *I am absolutely unpersuaded that Wyoming can rely on the assurances we receive from the federal government*" (Sullivan, 1992) (emphasis added).

2.2.5 Conclusions

The important findings we take forward from these MRS case studies are as follows.

1. Each of these organizations were attracted to the MRS hosting program by the upfront financial incentives to learn more about the program, the much larger upfront and ongoing annual fees to be paid by DOE to an MRS host, and the good-paying construction and operations jobs that were associated with such a facility;
2. Each had a local champion who initiated the discussions and with local support pushed for the large related economic benefits that would aid their largely rural and relatively poor communities; and
3. In the end, the efforts of all were defeated by the opposition of surrounding communities, their State government's mistrust of Congress and the federal government[14], fear that "temporary/interim storage" would become "permanent," and that the negative stigma associated with the state becoming the home to a large portion the nation's SNF would impact tourism and other businesses.

Important to DOE's efforts to use a collaboration-based process to site a federal CISF in the near future, is that such a facility will require the agreement/acceptance of the local community, as well as the surrounding communities and regions who, in past siting efforts, have not been considered for financial benefit from the facility and the concurrence of the state government that may have wider economic and political concerns.

[14] Federal government issues included the involvement of agencies including the Department of Interior (DOI) and Bureau of Indian Affairs (BIA) on subjects related to land use, mining, etc.

2.3 Private Fuel Storage, LLC

Private Fuel Storage LLC (PFS) is a limited liability company that was formed in 1996 by eight U.S. utilities serving more than 17 million customers in 21 states (PFS, 1997). PFS was formed in order to seek temporary SNF dry cask storage options for the utilities until the federal government begins accepting their SNF for permanent storage. The utilities that formed PFS currently store the SNF at their reactor sites but were concerned with continued production of SNF from their reactors and increasing on-site dry cask storage needs. Due to ongoing security needs, utilities cannot fully decommission a reactor site until the SNF at the site is removed (Davis v. Utah, 2010).

The site chosen by PFS for a commercial CISF was located on the Reservation of the Skull Valley Band of Goshute Indians, approximately 27 miles west-southwest of Tooele City, Utah. Multiple toxic and hazardous waste facilities surround the Reservation. To the south is the Dugway Proving Grounds (800,000 acres), where the U.S. Army conducts tests on biological and chemical weapons like anthrax, nerve gas, and bubonic plague. To the west is the Utah Test and Training Range, a vast area of desert that the U.S. Air Force uses for bombing runs and target practice by B-52 bombers and F-16 fighter jets. North and west of the reservation, a private company, Envirocare operates a landfill in Clive, Utah, which accepts low-level naturally occurring and accelerator-produced radioactive wastes and mixed wastes. East of the reservation is the Tooele Army Depot, one of the largest weapons depots in the world, and the Toole Chemical Agent Disposal Facility, home to nearly fifty percent of the nation's aging stockpile of chemical weapons which were destroyed and the facilities were removed by November 2014 (Davis v. Utah, 2010). In addition, DOE's Oak Ridge Office of Environmental Management (OREM) used intermodal containers to transport mercury contaminated demolition debris from a Y-12 process building that produced enriched lithium to the CleanHarbors Grassy Mountain facility in Clive, UT, where it was microencapsulated and buried (Salisbury & Mayer, et al., 2019).

In 1997, PFS applied to the U.S. Nuclear Regulatory Commission (NRC) for an away-from-reactor Independent Spent Fuel Storage Installation (ISFSI) specific license under 10 CFR Part 72 (NRC, 1997). This license is different from a general license issued under 10 CFR Part 50 that authorizes a nuclear power plant licensee to store spent fuel in NRC-approved dry casks at a site that is licensed to operate a power reactor. The PFS license is remarkably similar to the more recent away-from-reactor ISFSI licenses issued under 10 CFR 72 to Holtec International HI-STORE CISF in Lea County, New Mexico (NRC, 2023a) and Interim Storage Partners (ISP) in Andrews, Texas (NRC, 2021). In total, the NRC has licensed 14 away-from-reactor ISFSIs under 10 CFR 72, but these three are the only ones that are for dry cask storage facilities not

owned by the DOE or located at the site of a decommissioned nuclear plant and which are authorized to receive and store SNF from multiple licensed reactors (NRC, 2023b).

2.3.1 Skull Valley Band of Goshute Indians and SNF

The Skull Valley Band of Goshute Indians (Band) is a federally recognized Tribal Nation with 125 enrolled members, of which only about 30 lived on the reservation in June 2006. The Band became aware of the federal government's interest in locating interim SNF storage sites in the early 1990s through the creation of the ONWN in an amendment to the NWPA of 1982 (42 U.S.C. § 10242, 1988). The ONWN was charged with the responsibility of attempting to find a state or Tribal Nation willing to host a deep geologic repository or MRS facility, in conjunction with a permanent deep geologic repository that was to be built by DOE in Yucca Mountain. The Band applied for grants created by the program to conduct its own research into the storage of nuclear fuel. In 1990, it received a grant of approximately $100,000 that funded the Band executive committee's travel in 1992 to Sacramento, California's Rancho Seco Nuclear Plant, Washington state's Hanford Site, Florida Power & Light nuclear facilities, and Virginia's Surry Nuclear Power Plant. A second grant of approximately $200,000, sent the committee in 1993 to Japan (Takai Vitrification Facility and Fugen Reactor), France (La Hague Reprocessing Plant and Centre De L'Aube low-level waste site), the United Kingdom (Sellafield Reprocessing Plant), and Sweden (CLAB Facility).

Four Tribal Nations reached the final stage of consideration, and the Band thought that they were close to signing an agreement with the DOE in 1993 when the federal MRS program was cancelled (Weiss, 2004). Shortly thereafter, several utility consortiums reached out to the Tribal Nations that had shown the strongest interest in hosting an SNF storage site. By 1996, PFS and the Band were ready to sign a lease for the land needed to construct such a facility at the reservation (Weiss, 2004).

The original lease to store 40,000 tons of SNF in dry casks on reservation land for up to 40 years was executed by PFS in December 1996. An amended lease was executed in May 1997, which the Bureau of Indian Affairs (BIA) conditionally approved a few days later, and a second amended lease was executed in January 2002 to incorporate all of the mitigation requirements described in the final EIS. The final lease runs for twenty-five years, with an irrevocable option for an additional twenty-five-year term (Davis v. Utah, 2010).

2.3.2 NRC License Structure

The NRC issued an away-from-reactor special materials ISFSI license to PFS in 2006 (NRC, 2006). The license is similar to those issued to Holtec and ISP in that they require that the customer retain title to the SNF being stored in the CISF, and that there be an allocation of legal and financial liability between the licensee and its customers relative to the SNF being stored (NRC, 2006, 2021, 2023a). However, the PFS license is unique among the three in that it requires that funding commitments to construct, operate, and decommission the CISF be provided by its members prior to starting construction. The license lists several mechanisms for accomplishing this: (1) equity contributions pursuant to Subscription Agreements that secure storage space for a specific number of cannisters in the CISF; (2) pre-shipment customer payments pursuant to Service Agreements (through which the customers of the CISF commit to store their spent fuel at the CISF, and the CISF agrees to provide the customers with storage services); and (3) annual storage fee payments pursuant to Service Agreements (NRC, 2006). PFS would own the CISF and be responsible for site preparation; construction of the access road, administration building, visitors center, security and health physics building, operations and maintenance building, canister transfer building and storage pads; procurement of canister transfer and transport equipment; transportation corridor construction; and ongoing management of the SNF transportation logistics and secure operations of the facility (NRC, 1997).

2.3.3 Challenges to Start Up

Although PFS received a 20-year away-from-reactor ISFSI License in 2006, the CISF had still not been built as of the time of the publication of this report in 2025. The following highlights the several major challenges that PFS faced over that time and its current status.

2.3.3.1 State of Utah

Utah's governor at the time, Michael Leavitt, opposed the Band's interest in facilitating the storage of SNF on their Reservation, stating "We don't produce it. We don't benefit from it and we don't want to store it for those who do. We think it's unsafe in the context of our community ... [and] inconsistent with our vision of what we want this state to be" (Davies, 2009). Shortly after public notice that PFS intended to build a large SNF storage facility on Indian land in the State of Utah, the State enacted a series of

comprehensive and interrelated statutes between 1998 and 2001 to ban or limit the storage and transportation of SNF within the state. They included the following:

- A requirement that an SNF storage facility licensed by the NRC also obtain a state license for construction and operation. The state's licensing scheme required extensive analysis of health and safety issues related to the storage of SNF, all of which are areas regulated by the NRC under 10 CFR Part 72 to protect human health and safety and the environment (Nielson v. Private Fuel Storage, 2005).
- The applicant must pay a non-refundable "initial fee" of $5 million and thereafter "shall pay an additional fee to cover the costs to the state associated with review of the application, including costs to the state and the state's contractors for permitting, technical, administrative, legal, safety, and emergency response reviews, planning, training, infrastructure, and other impact analyses, studies, and services required to evaluate a proposed facility" (Nielson v. Private Fuel Storage, 2005).
- The applicant must also post a bond of $2 billion, or "a greater amount as determined to be necessary to adequately respond to," among other things, "any reasonably foreseeable releases" (Nielson v. Private Fuel Storage, 2005).
- The operator of an SNF storage facility must pay to the State an amount equal to 75% of the "unfunded potential liability" of the project. That Utah Department of Environmental Quality will determine that amount based upon the health and economic costs expected to result from "a reasonably foreseeable accidental release" of SNF (Nielson v. Private Fuel Storage, 2005).
- The statutory and common-law limited liability for officers, directors, and equity-interest owners of companies operating SNF storage facilities in Utah would be revoked (Nielson v. Private Fuel Storage, 2005).

PFS and the Band challenged Utah's statutes in the U.S. District Court (The Skull Valley Band of Goshute Indians and Private Fuel Storage v. Leavitt, 2002), arguing that the Atomic Energy Act of 1954 preempts any state regulation of SNF and that the preempting federal authority over Indian Affairs protects the Band as a federally recognized Tribal nation. In July 2002, the District Court granted a summary judgment decision to PFS and the Band. The Appeals Court for the Tenth Circuit affirmed this decision in 2004 (Skull Valley Band v. Nielson, 2004). Utah's Department of Environmental Quality then petitioned the U.S. Supreme Court for a Writ of Certiorari to the Appeals Court. The Supreme Court ruled that the Appeals

Court decision was correct and did not conflict with any decisions of the Supreme Court or any Court of Appeals. Further review was denied (Nielson v. Private Fuel Storage, 2005).

Separately, the State of Utah made two filings to the NRC in February 2002. One was a "Suggestion of Lack of Jurisdiction," claiming that the NRC lacked jurisdiction over PFS's license application. Utah argued that Congress had established in the NWPA of 1982 a comprehensive national nuclear waste management system for the storage of SNF and that the storage of such fuel at privately owned away-from-reactor facilities was prohibited. The NRC rejected Utah's argument that it lacked jurisdiction to issue such a license and denied Utah's request for rulemaking. In 2004, the State and others appealed this NRC ruling to the U.S. Court of Appeals, District of Columbia Circuit (Bullcreek v. NRC, 2004). The D.C. Appeals Court decided that nothing in the legislative history of the NWPA suggests that Congress intended to prohibit private use of private away-from reactor facilities. Accordingly, it denied Utah's petition for review of the NRC's Rulemaking Order.

2.3.3.2 Congressional Delegation

Seeking to derail the PFS project from a different direction, Utah Rep. Rob Bishop, with support from Reps. Chris Cannon and Jim Matheson, introduced H.R. 2909: Utah Test and Training Range Protection Act in House Natural Resources Committee in the 108th Congress to create a Cedar Mountain Wilderness area in Utah (over 100,000 acres) along the northeast border of the Band's reservation, including the land that PFS needed to construct a rail spur to transport the SNF casks to the storage site. This effort was opposed by the Bureau of Land Management (BLM) and BIA in testimony to the House Resources Committee Subcommittee on Parks, Recreation and Public Lands: "according to studies performed by the BLM, much of the area may not be suitable for wilderness designation… The lands encompassed in this bill contain acreage that was either found to be nonsuitable [*sic*] for wilderness during that review, or was never identified as having wilderness characteristics in the first place… Second, the bill would frustrate an ongoing administrative review process that began in 1997 with the conditional approval of a 20-year license to receive, transfer, and store spent nuclear fuel on the Skull Valley Indian Reservation" (Department of Interior [DOI], 2003). The Bill did not receive a vote. It was reintroduced in the 109th Congress as H.R. 1506 and again did not receive a vote (H.R. 2909, 2003; H.R. 1503, 2005). However, Rep. Bishop was able to have a comparable provision included in the 2006 National Defense Authorization Act (NDAA) (NDAA, 2006). The wilderness designation was built on Governor Leavitt's earlier effort to erect a

"land moat" around the Goshutes. If PFS could not use surrounding transportation corridors to move waste to the site, whether they had a storage license would be irrelevant (Davies, 2009).

2.3.3.3 U.S. Department of Interior (DOI)

For PFS to begin operating its proposed storage facility on the Skull Valley Band Reservation, it had to obtain the approval of several federal administrative agencies in addition to obtaining the ISFSI License from NRC. Additionally, each of these agencies had to comply with the National Environmental Policy Act (NEPA), which requires federal agencies to evaluate the environmental and related social and economic effects of their proposed actions.

With its preferred use of a rail spur to transport the SNF casks to the storage site blocked by the moratorium on land use planning in the Wilderness Area, PFS applied to the BLM for a right-of-way to build and operate an intermodal transport facility on federally controlled land located between the commercial rail line and Interstate 80. Further, because the Skull Valley Band is a federally recognized Tribal Nation and the United States holds its land in trust, PFS had to obtain the approval of their land lease agreement from the BIA. The lease was approved by the BIA Superintendent, contingent upon both the completion of an environmental impact statement (EIS) and the issuance of a license by the NRC (Davis v. Utah, 2010).

The administrative agencies involved (NRC, BLM, and BIA) chose to comply with NEPA requirements by acting together. The NRC took the lead, with the BIA and BLM acting as cooperating agencies, in preparing a draft EIS, seeking public comment on that document, and then issuing a final EIS. The final EIS that the agencies prepared recommended going forward with the project, but preferring the use of the rail spur, rather than the intermodal transport facility, to transport the SNF to the storage facility. Completion of the final EIS enabled NRC to issue an ISFSI License to PFS in 2006 (Davis v. Utah, 2010).

However, more senior level DOI officials assumed control of PFS' right-of-way application from the BLM and denied it after concluding that to grant the application would be against the public interest because there still remained too many unanswered questions about the project. The DOI also took over the Skull Valley Band’s lease approval request from the BIA and disapproved the lease for several reasons, including the need to protect the reservation for future generations of the Skull Valley Band (Davis v. Utah, 2010).

In 2007, the Band invoked the Administrative Procedure Act to obtain a review of the two decisions made by the DOI by the U.S. District Court for Utah. In July 2010, the Court vacated both of the DOI's decisions

and remanded PFS' right-of-way application and the Band's lease with PFS to the DOI for further consideration consistent with its decision (Davis v. Utah, 2010). The DOI did not challenge these decisions.

"On January 4, 2013, a Final Rule promulgated by the DOI became effective, giving American Indian beneficiaries more control over their land and removing much of the BIA's discretion on issues arising from the 'leasing approval process of Indian land.' The Final Rule specifically reforms the BIA's approval of leasing efforts made on American Indian land concerning residential, commercial, and renewable energy development" (Crockett, 2013).

2.3.4 Concluding Actions and Decisions

Ohngo Gaudadeh Devia (OGD) is an organization "dedicated to preserving and continuing the cultural heritage of the Skull Valley Band of Goshutes. The organization has committed itself to protecting the way of life of its members through the members' culture, physical surroundings and environment, and traditions. The organization was formed specifically to oppose the building of this SNF storage facility on the Goshute Reservation. Most of the members of OGD are members of the Skull Valley Band of Goshute[s]" (OGD, 1998). In 2007, the OGD and State of Utah petitioned the D.C. Appeals Court for a review of NRC's 2006 licensing decision (OGD v. NRC, 2007). The court determined that the petition was not ripe for decision because of the uncertain outcome of the lawsuit by PFS v. DOI in the District Court in Utah.

The D.C. Appeals Court ordered the Band and PFS to file a report within 120 days from the date of its Order, and every 120 days thereafter, on the status of any action challenging the DOI's denial of either the lease between the Band and PFS or the requested right-of-way across public land at issue in this case. The D.C. Court's June 26, 2007 Order also required the parties to file motions to govern future proceedings in this case within 30 days of the disposition of any action challenging either the denial of lease or the denial of a right-of-way (OGD v. NRC, 2007). When the Utah District Court vacated the DOI decisions in 2010, the parties filed a joint motion requesting the Court to enter an Order (1) holding this case in abeyance until further Order of the Court and (2) directing the parties to file status reports on December 23, 2010, and every 120 days (or such longer intervals of time as the Court may set) thereafter until the case is no longer held in abeyance (Davis v. Utah, 2010).

In 2022, OGD and the State of Utah again petitioned the D.C. Court to vacate the away-from-reactor SNF storage license issued to PFS, arguing that PFS had abandoned the project and asserting that the facility

would never be built. PFS responded that its NRC license is valid until 2026, and that it can be renewed for up to another 40 years. It requested that the petition to vacate be denied. However, the Band advised the court that it no longer favored the project and would not renew the expired lease or agree to any new lease for the land on which the storage facility is licensed to be built. The court decided to dismiss the Utah petitions as being moot, but it declined to vacate the NRC license (OGD v. NRC, 2022).

2.4 Anti-Nuclear Resistance to Storage of Spent Nuclear Fuel

The history of the efforts by the San Luis Obispo Mothers for Peace (MFP) to stop the construction, licensing, and continued operation of the Diablo Canyon Nuclear Plant and related on-site storage of its SNF in northern California, provide an example of the legal and political challenges that DOE may face as it seeks to use a CBS process to site facilities for the storage (or disposal) of radioactive material. The following is a short summary of MFP's many actions over the past 60 years that impacted the licensing and operation of the Diablo Canyon Plant and its storage of SNF, as well as the proposed consolidated storage of SNF in other parts of the country.

2.4.1 Diablo Canyon Nuclear Power Plant

As of mid-2012, California had only one remaining operating nuclear power plant, the Diablo Canyon Nuclear Power Plant near San Luis Obispo. Pacific Gas and Electric Company (PG&E) owns the plant, which consists of two units. Unit 1 is a 1,073 megawatt (MW) Pressurized Water Reactor (PWR) which began commercial operation in May 1985, while Unit 2 is a 1,087 MW PWR, which began commercial operation in March 1986. The twin reactors produce about 18,000 GWh of electricity annually, serving approximately 3 million people (California Energy Commission, 2020).

Diablo Canyon's operating licenses are scheduled to expire in 2024 and 2025 respectively, unless renewed. PG&E began the process of renewing its licenses in 2009, but in 2016 it announced plans to close the plant, citing cost of operations and the State's refusal to grant a renewal of the permits needed for the plant's cooling system, which is reliant on drawing water from the Pacific Ocean to condense steam that is used to drive the turbine systems. PG&E announced a Joint Proposal with several labor and environmental organizations to increase its investment in energy efficiency, renewables, and storage while phasing out nuclear power. The Joint Proposal was approved by the California Public Utilities Commission (CPUC) in

January 2018, and in February, PG&E withdrew its application to the NRC for a licensing extension (California Energy Commission, 2020).

But in 2022, Governor Newsom and the California Legislature did an about-face and passed SB 846 that extended the PG&E state licenses by 5 years to 2029 and 2030 and provided PG&E with a $1.4 billion forgivable loan (Nuclear Newswire, 2023). From the Bill: "Preserving the option of continued operations of the Diablo Canyon power plant for an additional five years beyond 2025 may be necessary to improve statewide energy system reliability and to reduce the emissions of greenhouse gases while additional renewable energy and zero-carbon resources come on-line and until those new renewable energy and zero-carbon resources are adequate to meet demand" (Nuclear Newswire, 2022). The CPUC followed by approving the change. The NRC in turn allowed PG&E to restart its request for a 20-year license renewal and to continue operating the two reactors during the period the renewal application is being reviewed by NRC staff.

2.4.2 Mothers for Peace

The San Luis Obispo MFP chapter was formed as an anti-Vietnam war group in 1969. In 1973, MFP committed to using the legal system to oppose the Diablo Canyon Nuclear Plant, and by extension all nuclear facilities (MFP, 2024a). In 1978, it retained the Los Angeles-based law firm, Center for Law in the Public Interest, to represent its interests. MFP obtained a federal 501(c)(3) non-profit tax status to enhance its fundraising abilities. To have legal standing to intervene in Diablo Canyon licensing decisions, the majority of MFP's members must live within a 50-mile radius of the plant. Its membership is predominantly, but not exclusively, women (MFP, 2024a).

Throughout the 1980s, MFP sought to stop the construction and then start-up of the Diablo Canyon reactors by raising fears that an earthquake might cause a catastrophic release of radioactive materials. After the twin reactors became operational, MFP's focus turned to the SNF stored at Diablo Canyon and PG&E's need to substantially increase the amount that could be held in the water pools. In 2002, PG&E applied to the County of San Luis Obispo and the NRC to build and store SNF on-site in 140 dry casks in an ISFSI.[15] The NRC approved the application and construction was started in 2005. However, MFP began

[15] Refer to NRC Docket 72-76, "Application of Pacific Gas and Electric Company (PG&E) under 10 CFR part 72 for permission to construct and operate an independent spent fuel storage installation (ISFSI) at its Diablo Canyon Power Plant (DCPP) site near San Luis Obispo, California" for additional information.

raising public concerns about possible terrorist attacks on the dry cask storage facility. It succeeded in obtaining a Ninth Circuit Court order in 2007 (San Luis Obispo Mothers for Peace v. NRC, 2006) that NRC must do an additional analysis of the environmental effects of a possible attack.[16] More than 150 state and national organizations filed comments with the NRC criticizing the preliminary supplemental terrorist threat analysis, however PG&E was authorized to begin loading SNF into the ISFSI in October 2008. In July 2009, the Ninth Circuit Court of Appeals (Ninth Circuit Court of Appeals, 2009) ruled against MFP, agreeing that NRC could rely on the nation's defenses to protect nuclear power plants from attacks from the air.

In November 2009, PG&E announced that it had applied for renewal of the plant operating licenses, and, four months later, MFP filed with the NRC for standing as intervenors to oppose the renewal. In May 2010, the Atomic Safety and Licensing Board (ASLB) heard oral arguments on MFP's challenge to the renewal application, and in August, a 3-judge panel granted MFP's request for a hearing on four of the five contentions filed. However, in October 2011, the NRC Commissioners affirmed the ASLB decision to grant MFP a hearing, but only on the single contention that studies of the Shoreline Fault must be incorporated into the final licensing decision for Diablo Canyon. The other three contentions previously approved by the ASLB were rejected (MFP, 2024a).

On June 8, 2012, the Washington D.C. Circuit Court of Appeals vacated NRC's Waste Confidence Rule. It concluded that the NRC acted improperly when it failed to consider all the risks of storing spent fuel on site at nuclear power plants for longer than the plant's license. In August of that year, the NRC put a hold on final decisions on all nuclear reactor licenses and license renewals until requirements of the June 8th decision by the D.C. Court of Appeals could be met (NRC, 2012). In March 2014, MFP's attorney petitioned the NRC to halt licensing procedures for Diablo Canyon and 11 other nuclear power plants until the new and significant consequences of a spent fuel pool fire have been considered. In April 2015, the NRC announced that the staff would start processing PG&E's application for license renewal, which had been on hold, but that PG&E must submit a detailed seismic analysis for Diablo Canyon by June 30, 2017 (80 F.R. No. 126, 2015). In October 2015, the ASLB granted PG&E's motion for summary disposition of MFP's contention regarding the Shoreline Fault, leaving MFP with no contentions to the license renewal allowed by the NRC. A three-judge panel of the U.S. Court of Appeals for the District of Columbia denied the June 29, 2015, petition filed on behalf of MFP and seven other groups appealing the NRC's Continued Spent

[16] U.S. Court of Appeals for the Ninth Circuit held that the NRC's "categorical refusal to consider the environmental effects of a terrorist attack" in this licensing proceeding was unreasonable under NEPA. The Ninth Circuit remanded the "NEPA-terrorism" question to the Commission for "further proceedings consistent with this opinion."

Fuel Storage Rule on the grounds that the court should not substitute its judgment for that of the agency (MFP, 2024a).

On June 21, 2016, PG&E announced that a Joint Agreement[17] had been reached with several environmental and labor organizations that the Diablo Canyon Nuclear Power Plant would be closed at the end of the current licenses in 2024 and 2025 and the power would be replaced with renewable energy. A formal filing of the proposed closure of Diablo Canyon was submitted by PG&E to the CPUC on August 11, 2016. MFP filed its Response to PG&E's Joint Proposal with the CPUC on September 16, 2016, arguing the plant should be shut down immediately and that the nine additional years of Diablo operations was unwise, unsafe, too expensive, and unnecessary. MFP stated that renewable sources of energy to replace the needed portion of electricity from Diablo would be available very soon (MFP, 2024a).

In September 2018, MFP was one of seven environmental organizations that filed a legal challenge with the NRC opposing the plans of Holtec International/Eddy-Lea Energy Alliance to construct and operate a CISF for SNF in southeastern New Mexico.[18] In May 2019, the ASLB denied the request for an evidentiary hearing challenging the proposed CISF. In April 2020, MFP sent a letter to Congressman Salud Carbajal requesting that he contact the NRC and demand that a public meeting be held to discuss the proposed transport of radioactive waste from Diablo Canyon to Holtec's proposed CISF in southeast New Mexico because of the dangers involved in transporting the waste. In November 2020, MFP joined other organizations in opposing ISP's application for a license to build and operate a CISF for SNF in Andrews County, Texas. In June 2021, in a meeting with Congressman Carbajal, MFP advocated for more robust casks and expressed opposition to consolidated interim storage and favored keeping the SNF at Diablo Canyon until there is a permanent solution (MFP, 2024a).

MFP opposed the State's change in position and decision in 2023 to grant PG&E an extension to the Diablo Canyon operating licenses and is currently opposing PG&E's efforts to obtain a 20-year extension from the NRC, as well as a 40-year extension for its ISFSI facility (MFP, 2024a).

[17] This agreement was to govern closure of Diablo Canyon when the existing NRC operating licenses expired. Subsequently the agreement provided for replacement of Diablo Canyon with a greenhouse gas-free energy portfolio that included a 55 percent Renewable Portfolio Standard commitment by 2031.
[18] It is important to note that Holtec was the operator of the existing Diablo Canyon ISFSI at the time.

2.4.3 Conclusions

This case study demonstrates the legal recourse available to public interest groups and nonprofits who oppose nuclear facilities in the United States. The actions and feedback of MFP, and other prior anti-nuclear activists, summarized here and elsewhere should be considered as part of the CBS process. Echoing this point, the President of the San Luis Obispo MFP was a signee on a 2022 letter responding to DOE's request for information regarding the CBS process (DOE, 2022).

2.5 WIPP and Transportation as an Evolving Story

Since the demise of the location science era[19], organizations have been increasingly challenged in their efforts to site facilities that have associated real or perceived risks. The difficulty is increased when organizations must also overcome opposition to proposed routes to transport material to and from sites. Site managers have three options available to them: (1) find safe pathways; (2) adjust existing ones, or (3) build new routes. When options (1) or (2) are used, organizations can increase public confidence by using superior equipment and hire specially trained drivers to increase the safety of transportation. Yet, the reality is that pathway communities may be fearful of the shipments, and depending upon the proposed locations may use political influence to oppose routes. The irony is that building special containers, using special vehicles to protect the materials, requiring special driver certifications, adding security personnel to accompany deliveries, and imposing restrictions on informing local communities is taken by some as an indication that worrying is appropriate.

Whether the material is nuclear fuel and waste, liquefied natural gas (LNG), oil, or other locally unwanted land uses (LULUs), developers should assume they will face transportation-related opposition. Touting an enviable record of transporting nuclear materials in the United States is necessary but will not deter opposition. For example, the probability of an off-site transportation accident (albeit a low probability event) is a major reason why the U.S. Congress ordered the U.S. chemical weapons stockpile to be destroyed on-site. Given past experience with opposition to transporting hazardous material in the U.S., it is expected that transporting SNF will also be a subject of debate among communities and those responsible for siting a federal CISF.

[19] Refer to Section a.i of the historical preface to this report for additional information.

In this section, we focus on deliveries of transuranic waste (TRU) to WIPP, which is the U.S.'s only deep geologic repository for long-term disposal of defense-generated TRU. Located 655 meters below the surface near Carlsbad, New Mexico, the storage site received the first shipments from Los Alamos in 1999. To better understand the scale of transportation operations to WIPP, we refer to Knerr (2021), manager of the DOE Carlsbad Field Office in 2021, who reported that the largest number of shipments to WIPP in a week were 27, and that in 2021, WIPP averaged 10 shipments per week.

The transportation of TRU waste has evolved over the past quarter of a century and has produced important lessons learned. WIPP is located in southeast New Mexico, and the area leading to the site has a limited number of routes. Unless otherwise directed by the state government, shipments from the north and west go through Santa Fe, New Mexico's capital city. That is, shipments from four national laboratories (Idaho National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratory) involve passage through Santa Fe. These four sites have constituted the vast majority of shipments to WIPP to date, which means that state officials are aware of, and possibly witnesses to, any transportation issues involving WIPP. The remainder of this section describes the negotiation processes between DOE and the state to develop transportation plans for WIPP, as well as the enduring communications DOE has engaged in with state and Tribal representatives regarding shipments of TRU to WIPP.

2.5.1 Transportation and the Waste Isolation Pilot Plant Land Withdrawal Act

The most recent version of the WIPP Land Withdrawal Act, P.L. 104-201, has 23 sections (Waste Isolation Pilot Plant Land Withdrawal Act of 1996,1996). The law begins with goals, definitions, and site-based issues. Section 15 specifies that the DOE will pay $20 million a year to New Mexico for 14 years beginning with fiscal year 1998. It does not specify what the funds are to be used for by the State, although it does specify that a portion will go the Lea and Eddy counties where WIPP is located. **Section 16 discusses transportation. It is the longest section of the legislation** (emphasis added), and specifies involvement by the NRC, as well as training, equipment and other requirements about transportation to WIPP.

Sections d, e, and f of Section 16 are quoted below:

> *"(d) TRANSPORTATION SAFETY PROGRAMS. — The Secretary shall, to the extent provided in appropriation Acts, provide in-kind, financial,*

technical, and other appropriate assistance to any ***State or Indian tribe*** [emphasis added] *through whose jurisdiction the Secretary plans to transport transuranic waste to or*

from WIPP, for the purpose of WIPP-specific transportation safety programs not otherwise addressed in this section. These programs shall be developed

with, and monitored by, the Secretary.

(e) ***SANTA FE BYPASS.— No transuranic waste may be transported from the Los Alamos National Laboratory to WIPP until—***

(1) an amount of funds sufficient to construct the Santa Fe bypass has been made available to the State;

(2) the Santa Fe bypass has been completed; or

(3) the Administrator has made the certification required under section 8(d)(1)(B). [emphasis added]

(f) STUDY OF TRANSPORTATION ALTERNATIVES.—

(1) IN GENERAL.— The Secretary shall conduct a study comparing the shipment of transuranic waste to the WIPP facility by truck and by rail, including the use of dedicated trains, and shall submit a report on the study in accordance with paragraph (2). Such report shall include—

(A) a consideration of occupational and public risks and exposures, and other environmental impacts;

(B) a consideration of emergency response capabilities; and

(C) an estimation of comparative costs.

(2) REPORT. — The report required in paragraph (1) shall be submitted to the Congress not later than 1 year after the date of the enactment of this Act" (Waste Isolation Pilot Plant Land Withdrawal Act of 1996, 1996).

These sections demonstrate New Mexico's concern about transportation of TRU to WIPP for disposal and set forth requirements that speak to the importance of New Mexico's values attached to Tribal Nations, other states, and especially the Santa Fe area as these relate to transportation, as will be demonstrated below.

2.5.2 Evolution of Transportation Safety Practices at WIPP in the Context of Trust

DOE has developed a major program for reducing transportation risk to WIPP, and it has built trust for its science as a result of the requirements and actions taken by this program. Based on radiation exposure limits, one part of the transportation-related requirements call for TRU waste to be moved in one of four types of NRC-licensed shipping casks. Three of the four types of acceptable casks for TRU shipment are for waste that can be handled (i.e., contact-handled waste). The fourth cask is for waste that, due to radiation levels outside the cask, requires remote handling. As part of the cask licensing process, the casks are subjected to penetration, burn, and immersion tests. Before a cask design is certified for TRU shipment, it must successfully pass each of these tests. Design certifications are valid for five years, that is, certification is not permanent but can be renewed.

Overall, the DOE has been involved in shipping TRU waste for more than two decades and has been improving the technical safety basis for shipping TRU waste; a number of best practices for TRU shipment are summarized below. DOE hires contracting companies who use certified and experienced drivers who must pass emergency response tests for TRU shipment to WIPP. Two drivers deliver each shipment, and drivers are required to rest at specified intervals. The vehicles are held to specific requirements, including tracking by satellite and by WIPP, and they are equipped with two-way communication systems. Trucks are required to stop at specific distances for inspection and, should there be a problem, tractors are replaced within a specified period of time. DOE's shipment practices have helped to establish a good record for technical trust regarding TRU waste transportation to WIPP.

DOE has also pursued communications-based trust regarding shipments. Options for shipping the waste have been part of the negotiations with the state of New Mexico and Tribal nations. Regarding the latter, DOE has established government-to-government relationships with 10 Tribal organizations in six states to reach agreements about routes, as well as accident prevention, communications, emergency preparedness, hazardous materials response training, and monitoring. The transportation process also mandates communications with states, but the fear of terrorism means that DOE does not disclose details about scheduling to local populations. However, this can occasionally result in local populations being startled by seeing cannisters carried on massive tractors and accompanied by security vehicles. The trucks carrying the TRU waste have been shown to be safe, but like enormous LNG tankers (see section 2.7), their scale may shock people, especially when an unsuspecting population encounters them.

Regarding values-related trust, DOE funded New Mexico to create a science expert group that could challenge DOE's plans at WIPP. Although the group is no longer funded by DOE, it was an important contributor to the WIPP transportation program. For example, transportation improvements and training to reduce risk have been funded. Further, the amended WIPP Land Withdrawal Act requires DOE to fund training programs and use routes that divert DOE's vehicles away from urban areas, especially around Santa Fe. Knerr (2021) indicated that much of the money provided by the federal government to New Mexico has been used for transportation. A total of almost $500 million was spent during 1995-2012 to build bypasses and conduct repairs near Santa Fe, Roswell, Carlsbad, Albuquerque, and other areas where WIPP shipments pass.

2.5.3 DOE and New Mexico Negotiations

The state of New Mexico regulates WIPP by way of the New Mexico Environment Department—which is responsible for issuing the facility a 10-year Hazardous Waste Facility Permit, in accordance with the provisions of the Resource Conservation and Recovery Act (RCRA). The reality that New Mexico holds the power to renew WIPP's Hazardous Waste Facility Permit has given New Mexico leverage in its negotiations with DOE. Jennifer Salisbury was Cabinet Secretary for New Mexico's Energy, Minerals, and Natural Resources Department when WIPP opened (Burger et al., 2022b). Salisbury recognized that the local population near WIPP was more supportive of the site than were people near Santa Fe and that the DOE had to prove its case. An experienced attorney with local, state, and national experiences, Salisbury was able to help negotiate and navigate the early traps associated with WIPP for New Mexico:

> "*It was essential to prove through science that it was safe to transport the waste to WIPP, and to store it there. It required coordinating all the agencies, the public, and the legislature. It required public meetings, and constant attention to the media and public. It required consistency of messages, smart people to mitigate the skepticism, convincing science information, and persistence. And more persistence. We had to keep moving forward…*" (Burger et al., 2022b).

Jenkins-Smith et al. (2011) conducted multiple public surveys in New Mexico that indicated gradually increasing trust in DOE over the course of WIPP operations, and generally increased within New Mexico, despite the increase of shipments over the past two decades. Ines Triay (Triay, 2002) was appointed manager of the Carlsbad field office in 1999. Her objective was to move TRU to WIPP—she noted that the number of shipments rose from about 1-2 a week to 17 over the course of her tenure. However, this is not

to say that DOE shipment of TRU to WIPP is without public concerns—for example, residents noticed these increased shipment rates, and over two decades later are concerned about the possibility for more shipments into New Mexico and an increase in the site's roles, such as proposed shipments of surplus plutonium for storage at WIPP (Dynes et al., 2020).

Resident trust in WIPP was jostled in February 2014 when an underground fire closed the site for three years, although emissions from the fire were observed to be minimal. However, New Mexico fined the DOE $73 million in response to the occurrence. In May 2015, the State and the DOE agreed to use the $73 million for road and water infrastructure improvement and emergency preparedness. Notably with regard to transportation, $34 million was allocated to road improvements in and around Santa Fe and another $12 million was allocated road improvements near Los Alamos (New Mexico Environment Department, 2015). Much of the money was spent on transportation, an expectation that may be part of negotiations and compensation undertaken for future CBS processes. Additionally, New Mexico established a Radioactive Waste Consultation Task Force that involves six state agencies (Environment, Health, Transportation, Public Safety, Homeland Security, and the State Fire Marshal's Office) that meet with DOE representatives quarterly to focus on WIPP-related transportation issues.

On June 27, 2023, New Mexico reached agreement with DOE about renewing WIPP's permit. The agreement includes additional state oversight of WIPP, an updated reporting on legacy waste in the U.S. that could conceivably go to WIPP, and stopping waste shipments if there is evidence of a human health or environmental threats. DOE agreed to search for another deep geologic repository not located in New Mexico, and several other provisions. It is clear that the state government has negotiated for more say in decision-making—a logical progression, especially if trust is compromised as it was during the year 2014 underground fire.

2.5.4 Conclusions

Overall, the WIPP case study illustrates that a siting agreement at a specific location may not only face site-related local issues but also challenges with transportation of waste to the chosen site. Based on its WIPP programs, DOE has established a working blueprint on what it will need to do regarding transportation of radioactive waste that may prove useful as part of future CBS efforts. Further, the WIPP case study demonstrates DOE's ability to work with other federal agencies, as well as state governments and Tribal Nations, to both communicate radioactive waste shipment information and to negotiate terms

for its transportation. One interesting challenge with respect to a federal CISF is the idea of interim storage—DOE should be prepared to field questions regarding the definition of "interim" in this context, and its impacts on recovery and reshipment in the future.

2.6 Fernald as a DOE Success Story

In this section we review the Fernald stakeholder collaboration process, focusing on implications for DOE's CBS program. We use the U.S. Environmental Protection Agency's (EPA's) superfund site profile and reports from Fernald's community groups. After summarizing site information, we focus on the institutional processes that led DOE officials to declare Fernald as a success for all sides.

The Fernald site is located in Fernald, Ohio about 20 miles northwest of Cincinnati in a rural area. The 1,050 acre site produced high-purity uranium metals for nuclear reactors producing plutonium for weapons during the period 1951-1989. These processes left soil and groundwater contaminated with radionuclides—including uranium, radium, thorium—sludges and other hazardous chemicals. The EPA estimated that 31 million pounds of uranium products, 2.5 billion pounds of waste, 255 buildings and structures, and 2.75 million cubic yards of contaminated soil and debris required remediation (U.S. EPA, n.d.). After closure, Fernald was classified as a Superfund National Priorities List (NPL) site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S.EPA, n.d.). A Federal Facility Compliance Agreement between DOE and U.S. EPA in 1986 began with a Remedial Investigation/Feasibility Study to identify remediation needs. These investigations led to the site being divided into what EPA labels "operable units" (U.S. EPA, n.d.):

- Operable Unit 1: required excavation and cleanup of eight waste pits containing 600,000 cubic yards of materials, removal and drying, and in some cases off-site shipment by rail.
- Operable Unit 2: involved remediation of six waste disposal areas, including excavation of about 350,000 cubic yards of waste material and its disposal in an on-site disposal facility, but only if it met an agreed upon waste criteria. Wastes that did not meet the criteria were moved off-site.
- Operable Unit 3: entailed remediation of 223 production and remediation structures, that is, shutdown, removal of piping and building materials, demolition and disposal of some of the materials on-site and others off-site.
- Operable Unit 4: required cleanup of silos containing 11,000 cubic yards of uranium, thorium and radium waste materials, and then off-site disposal.

- Operable Unit 5: has required remediation of soil and groundwater contaminated areas across the site, including excavation and on-site disposal of some contaminated soils and off-site for others.

The majority of remediation processes took 17 years (1989 through October 2006), while collection and treatment of contaminated groundwater continues. The total cost of remedial activities is estimated by the EPA at $4.4 billion (EPA, n.d.). In addition, a 223-acre portion of the Great Miami Aquifer, underlying the site, was found to be contaminated at levels above radiological drinking water standards, and continues to be monitored.

The DOE's Office of Environmental Management (DOE-EM) was responsible for initial remediation. In January 2007, post-remediation responsibilities transitioned to the DOE Office of Legacy Management. The site now serves as a wildlife park and as a place where visitors can hike and stop at an education center to be acquainted with the site's history. DOE maintains control of the site for the conceivable future.

2.6.1 Negotiations Among DOE, EPA, the State of Ohio, Local Parties, and the Site Contractor

It is fair to say that the positive outcomes presented above seemed unlikely during the mid-1980s when Fernald was characterized in negative terms. Four decades later, the Fernald site is a model of cooperation between U.S. DOE, U.S. EPA, the Ohio EPA and health departments, the Fernald Citizen's Task Force, and other local stakeholders to reach consensus on cleanup and a future for the site. Arguably, given the high cost of the cleanup and involvement of many parties, the processes used at Fernald may not be plausible at other locations, although the DOE developed similar processes for use at Mound and Rocky Flats. This section uses Fernald Citizen Task Force reports (Fernald Citizens Advisory Board, 2016), a previous site visit, and borrows heavily from chapter 8 in Greenberg and Schneider (2017). We highlight the use of collaborative processes and charrettes—as well as focus groups, local surveys, public outreach, and other processes—to advance the cleanup process at Fernald.

Fernald's location was not the result of deep collaboration with the local communities and the state government. The federal government chose the area without local input for several reasons. One was that nuclear reactors for producing plutonium centrally located at the Oak Ridge (TN) site that produced and recovered plutonium at the pilot-plant scale, and at the Savannah River (SC) and Hanford sites where plutonium was made and recovered at an industrial scale. Further, Fernald could receive imported uranium

through New York and New Orleans ports, and Cincinnati provided a nearby labor force. Water resources were also plentiful—the Great Miami aquifer was the main water source for the site. Finally, the farm area was relatively easy to build on.

In 1984, more than three decades after opening, the Fernald site began to receive negative attention. Media coverage pointed out that Fernald facilities had been releasing uranium into the air and into groundwater (the Great Miami aquifer is a sole source aquifer for many people in the area). When a worker was found dead on the site, some assumed a coverup was occurring. The death was reported on the television show *Unsolved Mysteries* on June 19, 1984 (Unsolved Mysteries Wiki, 1994).

Negative attention continued to mount. Ohio residents filed a class action suit against the site. Noble (1988) summarized the accusations against DOE in the New York Times, including that the site allowed uranium and waste to leak from the site. The television news show *60 Minutes* dedicated a segment of a show to Fernald. Local and state governments also became involved in pushback against Fernald—local elected official asserted that DOE was in effect waging chemical warfare against local residents, and the State of Ohio sued the federal government about Fernald.

The U.S. Centers for Disease Control and Prevention (CDC) conducted an exposure assessment, focusing on lung cancer, initially, in a circular area with a radius of 10 kilometers from the center of the site. As the study progressed, the CDC added other cancer outcomes to the study. The CDC estimated an extra 1-12% cancers in the region, mostly lung cancers among former smokers (CDC, 2000). Although these results were not alarming to everyone, they did add to the litany of public distrust regarding the Fernald site.

In response, the DOE initially proposed to try to return the site to its pre-DOE ownership environmental levels at an estimated cost of $7-$10 billion. For context, this cost was over 150 times the average superfund cleanup cost in the United Sates at that time (about $40 million). In addition, returning the site to an earlier condition would require scraping a massive amount of soil from the site and transporting it through this rural area.

The lawsuit brought against the DOE was settled in 1989, and the immediate health concern of the nearby public was addressed by offering bi-annual health monitoring and compensation. The DOE and the State of Ohio agreed to establish a CAB for acquiring input on priorities and to try to build trust. DOE later used this approach at Mound, Rocky Flats, and other closed sites.

2.6.2 The Advisory Board of the Fernald Citizens Task Force

Advisory boards are a common decision-informing and sometimes decision-making mechanism used to build trust and to lead to agreements. Some parties strongly favor recommendations and others are less favorably disposed to recommendations but do not withdraw (Applegate, 1998; Gray, 1989; Hartnett, 2011; Saint & Lawson, 1994; Susskind et al.,1999). In other words, the outcomes of collaborations are a product of a group working together. Consensus organizations, such as CABs, promote collaborative processes because the parties reflect many perspectives and should help to reduce conflict during decision-making. Note, however, that a consensus decision is not a guarantee that a decade or two later, *post hoc* analyses will show that the collaborative decision was the best decision in regard to human health and safety, ecological outcomes, economic or political outcomes.

Collaboration takes time and requires human and capital commitments. Also, some initial participants may be unable to bargain about options that deeply challenge their values. Whether the site is proposed for a windmill, a neighborhood solar site, an LNG plant, or a facility for managing (or disposing) of radioactive material site (such as Fernald), sometimes it is not possible for groups to reach common ground because of personal or group values. Collaborative processes should be able to eliminate or markedly reduce mistrust due to differences in information and communication. Yet, even after participants reduce differences associated with information and communications, values and experiences emerge that can undermine building a consensus.

In addition to immutable values, the following five are the challenges and/or risks of collaborative processes:

- A few participants dominate the process because of their knowledge and force of their personalities, whereas others do not have the space to represent their views;
- Absence of some of the most important parties because of an unwillingness to assert their positions in a public setting;
- High costs in regard to time, resource needs, and expertise that lead to a loss of enthusiasm for engagement over time;
- An increase in intensity of negotiations which is more than some participants are able to manage; and
- Failure to reach a consensus even after investing a great deal of time and resources.

Fernald was able to avoid some of the worst manifestations of these process failures. One reason was that Dr. Eula Bingham, a University of Cincinnati faculty member, was appointed chair of the CAB. Dr. Bingham had been director of the U.S. Occupational Safety and Health Administration (OSHA) from 1972 through 1976 under President Carter, had high credibility as an administrator and scientist. Dr. Bingham, in turn, recruited other strong people to serve on the Advisory Board of the Fernald Citizens Task Force, which was established in 1993 (see Applegate (1998)). The Task Force was asked to address four issues:

1. Preferred future for the site;
2. Allowable residual risk and appropriate remediation levels;
3. Disposal options for on-site wastes; and
4. Remediation priorities.

The Board appointed people to the Task Force with different skills and interests, including ex-officio members from federal and state agencies with knowledge on relevant subjects. Also, Fernald recruited an experienced professional facilitator who served for 13 years. The group created explicit rules and procedures, such as length of term for the chair and vice-chair positions. The Task Force adopted the principle that meetings were to be open to the public (>100 attended some meetings), and the public would have a comment period (Fernald Citizens Advisory Board, 2016). A great deal of their early work focused on understanding the site issues, which was provided by DOE staff, site contractors, regulators, as well as community information such as preferences and values. These briefings and discussions helped build trust among members.

In addition to standard practices, the Task Force tried to increase intragroup trust by trying charrettes. They used *FutureSite*, which in essence was a board game that allowed them jointly to explore the relationships between remediation and future land use (see Applegate and Sarno (1997) and the Fernald Citizens Advisory Board (2016)). They used these practices to create a site plan and design that was more agreeable to the population and more economical to the developers. Charrettes are a type of collaborative decision-making process that can help establish positive relationships that continue for years after the project work is completed. The limitations of charrettes are the same as for collaborative processes as a whole (listed above). They require substantial time commitments and tend to elevate the intensity of meetings. In the Fernald case, the use of charrettes allowed the members to get a better understanding of what the site would look like under different remediation scenarios. Similar tools could be a major advantage for CBS proposals.

As the process developed, the Task Force made suggestions that involved considerable debate. Removing all surface waste and shipping it to Nevada was considered to be destructive of the on-site environment and lead to substantial traffic. Alternatively, the Task Force recommended removing the most dangerous 20% of the material and leaving 80% of less hazardous wastes in the form of a large, covered hill on the site with a cap surrounded by a buffer zone. Two of the on-site silos were problematic. One solution was vitrification, which the Task force did not recommend; alternatively, the Task Force selected a cement-grout waste form as a fixing agent to prevent the material from becoming airborne.

Thousands of tons of technically enhanced naturally-occurring radioactive material (TENORM) waste will continue to be stored on site. Uranium, along with 49 other constituents of concern (Powell et al., 2010) (including organics (EPA, 1996)) are removed from the aquifer via a pump-and-treat system. The remediation plan required the DOE and the regulators to agree to implement legally binding institutional controls. One of these is that DOE will continue to manage the disposal cell and the surrounding green space in perpetuity. Institutional controls play an important role in site remedies because they reduce exposure to contamination by limiting access and land use changes. They also guide human behavior. For instance, zoning restrictions prevent land uses that are not consistent with the level of cleanup (e.g., residential use). Institutional controls are in place in perpetuity.

2.6.3 Conclusions

A great deal of the group's time using charrettes focused on the site as a recreation facility. The committee wanted the site to be considered a local asset rather than a stigmatizing legacy (DOE, 2016). The regulators and DOE accepted these suggestions and many other recommendations. Arguably, without the Task Force, which evolved into the CAB, the DOE would have taken a quarter of a century and spent over $10 billion to manage this site. Instead, about $4.4 billion was spent over a decade to create a sustainable and protective engineered system supported by legal agreements, institutional controls, public education, and a recreation center. The three tools described in this section were pivotal in the process, and the initial framework spearheaded by Dr. Eula Bingham was the groundwork for people of exceptional quality to join a collaborative process and try different approaches to build and increase trust leading to a consensus.

Table 2 below is a nine-step process, originally developed by Greenberg and Schneider (2017) to summarize key steps for building collaborative processes, many of which were implemented in the Fernald cleanup process. Table 2 has been modified for relevancy to DOE's ongoing CBS efforts.

Table 2. Steps in a collaborative decision-making process. (adapted from Greenberg & Schneider (2017))

Steps for Successfully Implementing Collaborative Decision-Making Processes
1. Identify the issue(s) with sufficient precision that the facilitator and group feel that a consensus-building approach will work;
2. Identify parties to participate, which means finding people to represent a range of ideas, especially trying to include groups that if not included could sabotage the group's work;
3. Determine a place(s) to meet, someone to monitor/facilitate the process, and the financial resources available for the process. The last of these three can be a show-stopper. Multiple facilitated sessions with reporting back can be expensive, and often foundations or the federal/state government pay for collaborative decision-making without assurance that the results mirror their preference;
4. Organize the process to meet the needs of the participants. Indeed, this is a good way to determine if participants are able to work together. These processes normally take one of three paths usually determined by facilitator and/or community preferences, alas with no guarantees of success. One is to start with the relatively easy issues first, then go to the harder ones. Or vice versa? Or after initial discussions, participants could divide the issues into categories and create committees to make initial recommendations for those are the most problematic;
5. Define the issues in ways that are sensitive to the range of perceptions, values, and likely initial preferences in the group. For example, a proposed airport will be seen by some as more jobs, taxes and income and to others as a major locally unwanted land use that will degrade the area. Issues need to be defined in ways that will not break up the group process;
6. Define enough plausible options so that every participant feels that their ideas are being considered. After some discussion among the full group or sub-groups, members should discuss tradeoffs among options that will bring them closer to a consensus. There are bound to be some factual disagreements, and it is important that group members are involved in determining how these are going to be resolved;
7. Choose a decision and resolve differences among the parties. If this is a near consensus, then press to resolve differences, which is admittedly easier to say than to do;
8. Formally choose an option. This may be the most difficult step because if a group member is representing a larger group, s/he may have a difficult time persuading their colleagues to sign on;

9. Present the suggestions to the sponsors, which may be a challenge in reaching the parties, timing, and making sure that people do not feel that they were ignored.

2.7 Liquefied Natural Gas (LNG), Solar, and Wind Siting Efforts

This section is not directed at nuclear facilities or waste management, rather on three current species of fixed energy production facilities in the United States that have been expanding: solar, wind, and LNG. Solar and wind have been rapidly increasing as U.S. energy sources. Natural gas demand remains high in the U.S. and international demand has markedly increased. These trends mean that there are many opportunities for controversy related to solar, wind and LNG facility siting. Lessons for CBS, generally, can be learned from siting of LNG, solar, and wind—many of these may be relevant to DOE's CISF challenge. We undertook these case studies recognizing that there are basic similarities and differences among the three types of facilities and the proposed DOE spent fuel site(s). Risk perception is one difference. Nuclear and chemical waste sites are habitually perceived as unwanted land uses. The benefits to a region for accepting an SNF storage facility are to be determined by negotiation. LNG facilities may be a cause of concern for some, but in some places they are near plastic and other manufacturing facilities that create jobs and taxes that may help to ameliorate some public concerns. In other words, the comparisons are imperfect. Yet they may be valuable because successful and unsuccessful efforts to locate these facilities tend to follow patterns. These patterns should be valuable to DOE as it pursues its CBS policy.

Several decades ago, LNG was seen as a gas that would be imported into the United States because the United States was a large energy importer. That status changed to exporter primarily due to the development of shale gas. Europe has been the major destination for this gas—transported by massive tankers. Forecasts by McKinsey and Company (2024) are leveling off for natural gas demand in Europe and substantial increases are forecasted in Asia through the mid-2030s. In response to this market, many new LNG facilities have been built in the U.S., primarily in the South. However, there has been strong, persistent objection to some proposed sites, which has been captured and published by professional and business sources, as well as media. Solar and wind as energy sources have also been undergoing rapid expansion. Rather than serving an international market, these are intended for sites in the U.S. at scales ranging from small facilities in urban and suburban locations to large and centralized sites in rural places. LNG represents the case of relatively few large sites with coastal access, whereas solar and wind sites are far more distributed on the land and in water.

The literature on siting fixed energy production facilities is a valuable source of tactics and policies used by proponents and opponents, by local and state governments, and the courts to decide among proposals. Sorting through this massive literature allowed us to identify papers that summarize key lessons learned. In addition, we have added other references for those who wish to dive deeper into these interesting subjects.

2.7.1 LNG Facility Siting

Opposition to LNG and related facilities considered to be noxious[20] (Greenberg, 2018) takes the form of multiple strategic tactics to defeat the proposal or change it to the extent that is no longer considered objectionable. The five citations that follow are illustrative. For example, the Tran et al. (2019) paper frames the issue in the context of social movement theory in which multiple players try to continuously undermine the proposal at every level. For example, they undermine the economic benefits of the proposed projects by labeling them as mistakenly supporting an old fading economy, whereas the proponents paint a positive future economy. Second, opponents highlight possible human and ecological health risks, building a case from hazardous events that occurred in the past, and possible future events. Third, the opponents gain financial and political support and use public events to remind the parties of their opposition, and they will create public events to voice their views. The overall framework used by opponents to LNG facilities includes taking as long as required to embarrass proponents, winning over important policymakers, and otherwise making the proposed facility economically infeasible, unattractive, or too risky for proponents.

These tactics are a predictable response to adamant opposition due to lack of trust in the evidence brought by proponents, failure to communicate with communities, and practices seen as coercive by some communities to dismiss community concern, that is, violating public values of transparency and importance of land. The Tran et al. (2019) and Greenberg (2012) citations below illustrate when protracted efforts to defeat LNG proposals succeeded. The Erdle (2023) and Adler (2024) papers illustrate how state government processes and the courts influenced the outcomes.

[20] The term “noxious” is used by several researchers (e.g., Greenberg (2018), Fitzgerald & Aarts (1993)) to describe facilities that are generally objectionable. Thus, we choose to use the term “objectionable” henceforth in this report.

In reality, however, there are over 160 LNG terminals in the United States, and a pattern of successful new sites is striking. The approvals are concentrated in Louisiana and Texas, in areas with economies centered around oil and gas, as well as refining, and manufacture of plastics and other products. Despite strong opposition in some places, this has been a successful industry which has found the choosing location at or near existing plant sites (CLAMP) to be a successful approach to facility siting. Local and state governments, local works, and populations tend to be supportive. Medlock (2023) summarizes the recent history of the industry.

Citation: Tran, T., Taylor, C., Boudet, H., Baker, K., & Peterson, H. (2019). Case Studies in the Environment, pp. 1-7.

Type of Document: Journal Article

Document Summary: The article describes how social movement practices were critical in undermining arguments supporting an LNG facility in Clatsop County, Oregon. The audience is academic and practitioner. The central message is that framing the issue to appeal to the public and elected officials and ongoing pressure on the issue are both critical. The framing process to influence the decision needs to win over federal, state, and local government officials, private organizations, and the communities. If the siting process is collaboration-based, the decision-makers need to be persuaded about the need for the site and how it benefits the community now and in the future. This framing needs to be ongoing.

Document Limitations: Scope limited to single, but famous, proposed LNG site.

Relevant Portions: Entire Article

Relevant Key Points: Frame the issue to gain an advantage in key parts of the debate. The following four steps are essential:

- Focus on the future economy—not a declining current one;
- Use safety and fears of terrorism to shape public health and safety perceptions and preferences;
- Gain and maintain advantage by tapping into sources of money, skill and political power; and
- Capitalize on events to gain political leverage.

Cited References for Additional Research:

Stern, P.S., Dietz, T., Abel, T., Guagnano, G., & Kalof, L. (1999). Human Ecology Review. 6(2), pp. 81-97.

Boudet, H.S. (2011). Environmental Politics, 20(6), pp. 786-806.

Borel, K., & Westermark, A. (2018). Community Development Journal, 53(2), pp. 246–262.

Citation: Adler, D., Parnay, A., Stein, E., & Unel, B. (2024). New York, New York: Institute for Policy Integrity, New York University School of Law. [Online] Available: https://tinyurl.com/5n6f9fdc.

Type of Document: Report

Document Summary: This report finds wide variations among states in the processes they use to site and regulate utilities. The message is that even with a federally operated process, state government legal processes and cultures will be a challenge to navigate, especially for the public, who may give up in frustration.

Document Limitations: Scope limited to nine states, but a major contribution to understanding state variations.

Relevant Portions: Section II has key observations

Relevant Key Points:

- Provide financial support to groups that will allow them to recoup their expenses.
- Increase their access by providing information on a variety of platforms, and translations of materials, as well as interpreters as needed.
- Make it clear what type of public participation is possible and how it can occur.
- Provide resources to help people understand the issues.
- Be transparent about reports and data.

Cited References for Additional Research:

Whelton, S., & Eisen, J. (2019).Harvard Environmental Law Review, 43, p. 307.

Sant'Ambrogio, M., & Staszewski, G. (2018). Public Engagement with Agency Rulemaking, Washington, D.C.: Administrative Conference of the United States.

Citation: Greenberg, M. (2012). in M. Greenberg, The Environmental Impact Statement After Two Generations, pp. 78-110, New York, NY: Routledge.

Type of Document: Book Chapter

Document Summary: Using EIS reports, interviews and local reports, this chapter follows the path of a proposed LNG import site on the former site of what was the world's largest steel mill in 1958 (Bethlehem at Sparrows Point, MD). The Federal Energy Regulatory Commission (FERC) led the process and ultimately approved the site. However, state and local officials, the fishing industry, and health and safety officials adamantly opposed the facility and used permitting powers to delay the project. Ultimately, after seven years, the company decided against building the site. Adamant local opponents did not have veto power but they had access to powerful individuals who found state processes to block the project. Note the site has been reused, including for a goods shipping port, which is supported locally despite the local traffic and other impacts.

Document Limitations: The chapter was published before company ended its effort. The end point is reported by several papers below.

Relevant Portions: Chapter 4

Relevant Key Points:

- When opposition is unwavering and believes that the current decision-making process will not work for them, it will seek alternative paths to achieve its goals.
- The ultimate reasons for failure to site a facility may change over time, such as changing markets, new elected officials with different agendas, and developer economic failure. Opponents and proponents need to be flexible and wait for opportunities to strengthen their positions as conditions change.
- The parties will expand the geographical and temporal scope of impacts to fit their arguments. In this case, for example, considerable opposition was aimed at building the infrastructure needed to tie the port site to inland the pipelines.
- Locally credible speakers make a big difference to local perceptions and preferences. For example, the local fire chief underscored the potential of a fire that could not be

extinguished, and other trusted individuals expressed concern about a potential accident going under the Bay Bridge, and of the impact on fisheries.

- State and local officials discouraged the company.

Cited References for Additional Research:

Neal, M. (2013). Ruppersberger: LNG facility at Sparrows Point officially "dead in the water,' Patch, October 2, 2013.

Citation: Erdle Jr., J.C. (2008). LLLC V. Smith, 527 F.3D 120 (4th CIR. 2008), Energy Law Journal, V29, pp. 695-702.

Type of Document: Journal Article

Document Summary: The same LNG site case that is part of the previous citation. The previous book chapter places the legal case in the larger regional context of efforts to block this site from being used for an LNG import facility. The article describes how the U.S. court system is sought by both opponents and proponents of proposed facilities and can alter outcomes. In this case, the U.S. Court of Appeals for the Fourth Circuit judged that the Natural Gas Act preempted a zoning amendment that would have not allowed LNG facility at Sparrows Point. The Court of Appeals found that the zoning amendment was not part of Maryland's coastal zone legislation. It overruled Maryland's District Court, which permitted applying the zoning amendment. Had Maryland followed the appropriate procedures the zoning change would have been accepted, blocking the location years before the company withdrew. The central message is that parties will use the courts to push back against state actions.

Document Limitations: Scope limited to single case, but the case illustrates how both sides use the court system to pursue siting objectives

Relevant Portions: Entire Article

Relevant Key Points:

- The Federal court was predisposed to rule in favor of the state. But it did not because the state had not notified the proper federal authorities in the National Oceanic and Atmospheric Administration of this action.

- The State ultimately found another legal path to block the site by denying the needed permits.

Cited References for Additional Research:

Farah, N., Wilson, M., & Anchondo, C. Jordan Cove Project Dies. What it means for FERC, gas, Energy Wire. December 20, 2021. [Online] Available: https://eenews.net/articles/jordan-cove-project-dies-what-it-means-for-ferc-gas.

Citation: Medlock III, K. (2023). US LNG Exports: Supply, Siting, and Bottlenecks. Houston, TX: Blake Institute, Rice University. May 12, 2023. [Online] Available: https://www.bakerinstitute.org/research/us-lng-exports-supply-siting-and-bottlenecks

Type of Document: Report

Document Summary: Excellent summary of the LNG industry in the U.S., including the successes and challenges of this rapidly expanding industry.

Document Limitations: No detailed cases studies.

Relevant Portions: Entire Article

Relevant Key Points: There are over 160 LNG terminals in the U.S. and this report summarizes the rapidly growing industry, as well as the challenges, which include siting. The pattern that emerges is the agglomeration of LNG sites in areas with strong state support for the oil and gas industries, and worker and public support.

Cited References for Additional Research:

Disavino, S. (2023). US LNG Project Approvals on Track for Record New Volumes, Reuters. June 23, 2023. [Online] Available: https://www.reuters.com/business/energy/us-lng-project-approvals-track-record-new-volumes-2023-06-23/.

2.7.2 Wind and Solar Facility Siting

Opposition to wind and solar are muted in many communities because they are seen as sources of "clean renewable energy." Successes with in-home installations for solar power are widespread, and opposition is limited when marginal sites are turned into solar farms. However, large solar and wind farms do bring opposition. Several of the papers summarized below present a dazzling array of legal mechanisms devised by local governments to stop or slow down solar and wind installations. Nearly all 10 papers and reports summarized below focus on efforts to organize this opposition and negotiations to overcome local opposition. The consensus is that negotiations can work, and the papers highlighted below suggest several ways of organizing those negotiations for success, which include outreach, conflict resolution, and information jointly prepared by local populations. Above all the message is not to try to use the same processes in every location, but rather to be flexible in working with local groups—this requires patience and gradual, long-term trust building.

Citation: Duke, J., & Attia, B. (2015). Journal of Environmental and Sustainability Law, 22(1).

Type of Document: Journal Article

Document Summary: Comparison of processes to resolve disputes about solar facilities.

Document Limitations: Focused on California

Relevant Portions: Entire Article

Relevant Key Points:

- Compared to state legislation-litigation processes, dispute resolution processes are better for all the parties because they are less expensive, consume less time, and give the parties an opportunity to work with each other to find a resolution.
- Conflict resolution identifies the "best of bad" choices and an opportunity to build trust.
- Local planning experts can be hired as experts to find negotiated solutions.

Cited References for Additional Research:

Rosenthal, E. (2013). Florida State University Law Review, 40(4), pp. 995-1026.

Schmid, A. (1999). in The Fundamental Interrelationships Between Government and Property, Nicholas Mercuro and Warren Samuel (eds.) pp. 237-241, New York, NY: Routledge.

Citation: Wu, G. (2022). SDGG Action. [Online] Available: https://sdg-action.oef/renewables-siting-must-take-the-path-of-least-conflict/.

Type of Document: Newspaper Article

Document Summary: Demand is increasing so much that the developers and advocates must be prepared to move quickly to prevent some local governments and states from losing momentum in siting decisions to delays, not in my backyard (NIMBY) protests and other actions. Calls for agencies to be transparent and involve local publics in decision-making.

Document Limitations: California focus

Relevant Portions: Entire Article

Relevant Key Points:

- Provides examples of how opponents of wind and solar are taking steps to block projects, for example, designating areas as helipads. This is reminiscent of the era when local governments would classify areas as industrial and warehouse sites in order to preclude affordable housing and waste management sites.
- Developers need to avoid disproportionately locating in areas with people of color and poor people.
- Be prepared to compensate people, for example, farmers.
- Take visual impact concerns seriously.
- Make sure there is procedural justice and transparency in processes.
- Site in areas with brownfield sites, and other marginal land that would benefit from redevelopment. Coordinate with local and regional planners to find these sites.

Cited References for Additional Research: None

Citation: Eisenson, M. (2023). Climate Law. May 31, 2023. [Online] Available: https://blogs.law.columbia.edu/climatechange/2023/05/31/report-finds-228-local-restrictions-against-siting-wind-solar-and-other-renewables-as-well-as-293-contested-projects/

Type of Document: Blog, the 214 page report is cited below.

Document Summary: Document growing opposition to wind and solar sites across parts of the nation.

Document Limitations: Not as much policy analysis as is needed, report does provide documentation of the many policy steps to restrict solar and wind on and offshore, but the focus is not on solutions.

Relevant Portions: Entire blog

Relevant Key Points:

- An amazing array of obstacles have been devised to slow down the use of these technologies in the U.S. Some of these are not relevant to DOE's CBS options, but legal experts could marshal some of them as part of opposition.
- A key point is that overwhelmingly these obstacles are from county and municipal governments, not states.
- The author of the report considers these to be a strong challenge to implementing these energy sources.
- The DOE needs to consider the array of local obstacles this and other literatures have identified.

Cited References for Additional Research:

Eisenson, M. (2023). Opposition to Renewable Energy in the United States, New York, NY: Sabin Center for Climate Change Law. Columbia University.

Citation: Center for Agriculture, Food, and the Environment. (2022). Contract Negotiations for Solar PV Facility Agreements, University of Massachusetts, Amherst. February 2022. [Online] Available: https://ag.umass.edu/clean-energy/fact-sheets/contract-negotiations-for-solar-pv-facility-agreements

Type of Document: Fact Sheet

Document Summary: A short and well written guide for individuals that could serve as a model for DOE guidance to communities about how to write and review siting proposals.

Document Limitations: Terse, but well written for a public audience

Relevant Portions: Entire fact sheet

Relevant Key Points:

- Emphasizes taking care in preparing an agreement and provides multiple conditions to understand and question in an agreement.
- Handy to have as checklist for all parties to discuss.
- Good to have such a list prepared by parties before embarking on negotiations.

Cited References for Additional Research:

Carroll, M. (n.d.) How to Do a Residential Solar Site Survey. North Caolina Extension Service, North Carolina State University. [Online] Available: https://craven.ces.ncsu.edu/considerations-for-transferring-agricultural-land-to-solar-panel-energy-production/1000/.

Cleveland, P. (2022). How to Do a Residential Solar Site Survey, Eagle view. [Online] Available: https://www.eagleview.com/solar/how-to-do-a-residential-solar-site-survey-a-full-guide/.

Citation: Fast, S., Mabee, W., Baxter, J., Christidis, T., Driver, L., Hill, S., McMurtry, J., & Tomkow, M. (2016). Nature Energy, 1(2), pp. 1-7.

Document type: Journal Article

Document Summary: Summarizing lessons learned from Ontario's history of controversial wind siting projects.

Document Limitations: Focus on a Canadian province, not on U.S., but similarities are strong in this case.

Relevant Portions: Entire Article

Relevant Key Points:

- Language used in article conclusion resembles DOE's CBS logic to learn and be flexible.
- Building social acceptance requires time and patience.

- Key areas to the public were health concerns, the distribution of financial benefits, need to address landscape concerns, and meaningful participation opportunities. (All raised in the Preface of this report.)

Cited References for Additional Research:

Szarka, J., Cowell, R., Ellis, G. Srachan, P., & Warren, C. (2012). Learning from Wind Power: Governance, Societal and Policy Perspectives on Sustainable Energy. London, UK: Palgrave-Macmillan.

Raven, R., Mourik, R., Feenstra, C., & Heiskanen, E. (2009). Energy, 34, pp. 564-574.

Stedman, R. (2003). Society & Natural Resources,16, pp. 671-685.

Citation: Gillette, L., Silvyn, J., & Guiao, R. (2009). The Federal Lawyer, pp. 50-61.

Document type: Journal Article

Document Summary: Promote environmental conflict resolution to overcome controversial renewable energy projects based on hundreds of cases.

Document Limitations: No detailed case studies.

Relevant Portions: Entire Article

Relevant Key Points:

- Be prepared for negotiations about multiple issues with multiple parties in multiple places.
- Do not begin with the assumption that “green” projects mean public acceptance.
- Be prepared for failures, including drawn out and costly negotiations, litigation, delays, settling for less -than-desired project results, and increased hostility among the partners after the negotiations.
- Conflict resolution works best when the project is a priority for all parties; all stakeholders participate; no single party can dictate or resolve differences; and outcomes are uncertain.

- Conflict resolution is less likely to work when some parties do not think there is an issue or the issue does not seem important, or when one or more parties have other paths to achieve their objectives (e.g., litigation, political maneuvering).
- Two most important process issues are establishing the appropriate level of participation by stakeholders and setting expectations.

Cited References for Additional Research: None

Citation: Susskind, L., Chun, J., Beron, D., Chaudhuri, A., & Paul, S. (2024). Cell Reports Sustainability, 1(1).

Document type: Journal Article

Document Summary: A call for institutionalizing joint-fact finding and collaborative problem-solving.

Document Limitations: A how-to paper rather than a demonstration with an actual case study.

Relevant Portions: Entire Article

Relevant Key Points:

- Siting has historically been fragmented process with fairness issues.
- Existing processes do not necessarily require commercial developers to compensate, minimize or rectify impacts, which leads to opposition.
- Building social acceptance requires time and patience.
- Authors propose a national consortium of university-college based clinics to inform practice and policy.

Cited References for Additional Research:

Carley, S., Konisky, D., Atiq, Z., & Land, N. (2020).Environmental Research Letters, 15, 093007.

O'Leary, R., & Bingham, L. (2004). Promise and Performance and Performance of Environmental Conflict Resolution, Washington, D.C.: RFF Press.

Susskind, L., McKearnan, S., & Thomas-Larmer, J. (1999). Consensus Building Handbook: A Comprehensive Guide to Reaching Agreement, Thousand Oaks, CA: Sage.

Citation: Kowalczyk, A. (2021). Can Solar Developers and Farmers Find Common Ground?, Canary Media. August 12, 2021. [Online] Available: https://www.canarymedi.com/articles/can-solar-developers-and-farmers-find-common-ground

Document type: Newspaper Article

Document Summary: Discussion of tension between farmers and solar-wind developers and how to close the gap.

Document Limitations: An overview of issues and solutions based on experiences without a specific case study.

Relevant Portions: Entire Article

Relevant Key Points:

- Farmers fear the loss of productive land, pesticide applications on their property, and pollution on abandoned sites.
- It is critical to engage farmers with maps and ideas about shared benefits.

Cited References for Additional Research: None

Citation: Moore, S., & Hackett, E. (2016). Energy Research & Social Science, 11, pp. 67-78.

Document type: Journal Article

Document Summary: Discussion of cooperative methods to redefine what people value in their landscapes and find compromises that accommodate these values.

Document Limitations: An overview of issues and solutions based on experiences without a specific case study.

Relevant Portions: Entire Article

Relevant Key Points:

- Parties need to identify each other's views on land and understand and respect these views.

- Some accommodation can be made to varying views, but the views should not be an ongoing moving target during negotiations.

Cited References for Additional Research: None

Citation: Atran, S., & Axelrod, R. (2008). Negotiation Journal, 24(3), pp. 221-246.

Document type: Journal Article

Document Summary: Focus on how to understand and negotiate value-laden issues such as land and water.

Document Limitations: Most of the literature is about international cases.

Relevant Portions: Entire Article

Relevant Key Points:

- Water, land, appearance, and other elements are sacred to some parties in negotiations.
- These must be addressed with constructive solutions to make progress in negotiations.

Cited References for Additional Research:

Ziza, I. (2007). New England Law Review, 42, 591.

Chapter 3: Methods Used for BoK Compilation

3.1 Background

As described in Chapter 1, this BoK has been developed as resource for DOE and the Consortia and is immediately applicable to Phase 1B of the DOE process. The BoK describes experiences and best practices relevant to subjects including risk communication, participatory decision-making, siting ethics, negotiations and compensation, international siting experience, and Tribal engagement. The format and contents of the BoK have been tailored to address the most important themes regarding CBS (as determined by the CRESP team) within the timeline and resource limitations that exist for the project. The remainder of this chapter describes the methodology used to structure and populate the BoK.

3.2 Methodology

The BoK development process consisted of three major phases—reference compilation & review, reference screening & knowledge area selection, and BoK entry creation. Each of these phases is described in further detail below.

3.2.1 Reference Compilation & Review

The first step in developing the BoK was to identify an initial list of knowledge areas[21] and associated key references. The knowledge area starting point for BoK development was taken from the Milestone 1 description in Table 1 (above), and the reference list starting point for the BoK were those references used in the project narrative submitted to DOE for DE-NE0009342, *Moving Toward Collaboration-Based Siting of a Federal CISF: Improving Strategies for Community-Informed Decision-Making during Stakeholder and Tribal Engagements*. This initial list of references was reviewed, and information from each reference was compiled in a fit-for-purpose Microsoft Access ™ database.

[21] The term "knowledge area" describes "a category of practical information…represented by the compiled reference list" (EPRI, 2018).

An early step taken to identify additional references for review was to examine the citations in each reference for relevance based on title, abstract, and date of publication[22]. These additional references were then reviewed, and a similar process was performed for the citations in these documents. However, knowing the limitations of this "snowball" search method (Patton, 2015), the reference identification process was supplemented with keyword searches in relevant databases. The primary database used to perform keyword searches was Google Scholar, due to its expansive literature coverage that includes conference papers and government-sponsored reports in addition to peer-reviewed journal articles. The list of keywords searched is provided in Appendix A; examples include:

- "Collaborative siting;"
- "Risk communication;"
- "Radioactive waste management facility siting;"
- "Tribal engagement;"
- "Incentives for hazardous waste facility siting;"
- "Community participation in facility siting;" and
- Many others.

As described above, a Microsoft Access ™ database was created to store relevant information for each reference. The fields included in the database closely resemble those of the CURIE library[23] to support streamlined integration of records from the BoK into the CURIE database if DOE so chooses. The data input form, which describes each of the fields in the database, can be seen in Figure 2 below. Because a number of reviewers contributed records to the database, a user's manual was created for the database and is found in Appendix B below.

[22] The primary focus of the BoK is on references published since the 2012 BRC final report (BRC, 2012).
[23] https://curie.pnnl.gov/curie2-combined-search

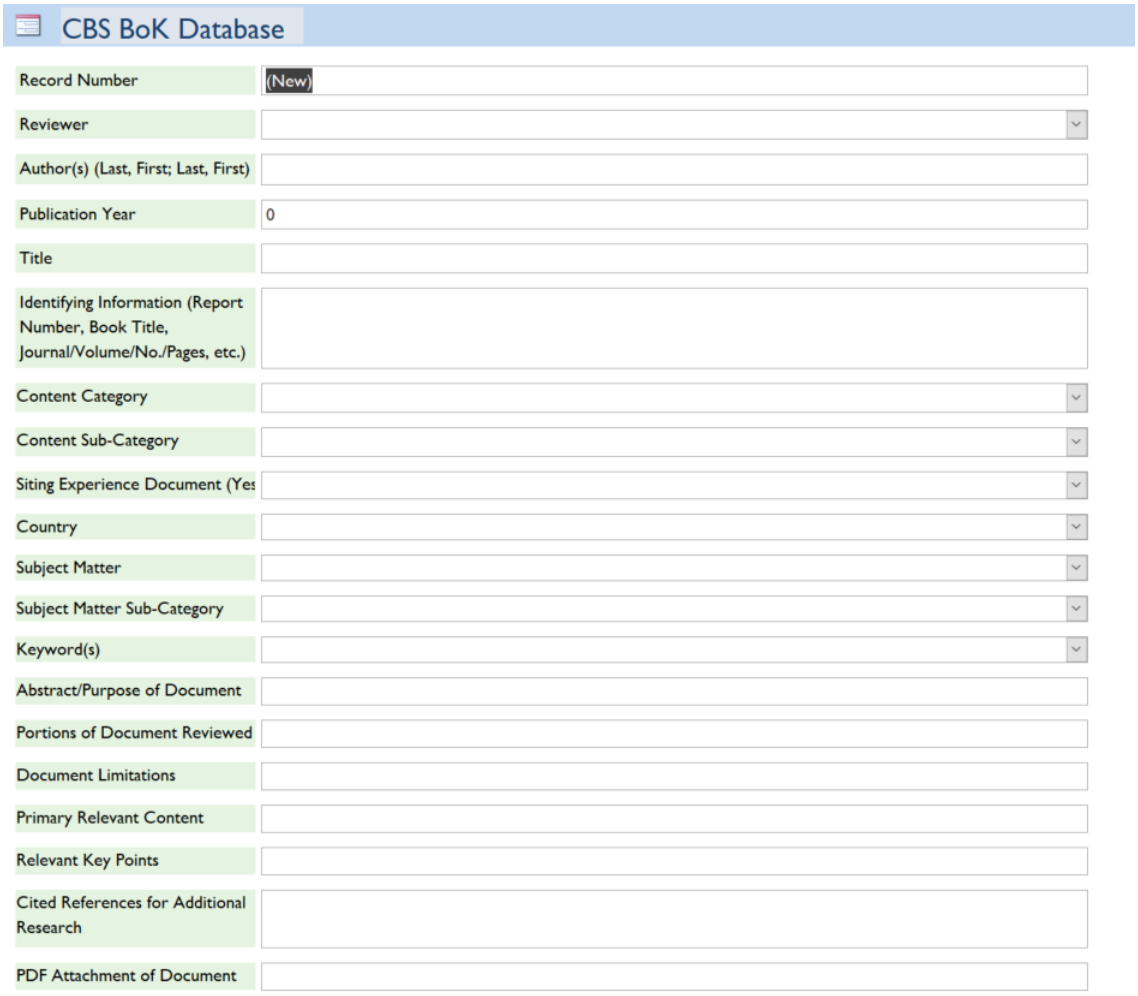

Figure 2. Data input form for BoK database.

3.2.2 Reference Screening & Knowledge Area Selection

After compilation and review of the majority of the references identified, the initial knowledge areas were re-examined and expanded into the following:

- Best Practices for Risk Communication and Engagement;
- Participatory Decision-Making Methods, Tools, Frameworks, and Best Practices;
- Reflections on the Ethics of Facility Siting and Process Rulemaking;
- The Role of Negotiations and Compensation in CBS;
- Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting; and

- Recommendations for Tribal Engagement.

Each of these knowledge areas is discussed in a separate chapter in this report.

High-value references were then identified for each knowledge area. The subjective criteria used to identify a "high-value" reference were as follows. For well-established subject matter (e.g., risk communication, community and Tribal engagement) guidelines and best practices reports that summarized most or all of the following topics were preferred: purpose, context, frameworks, methodologies, and tools. Preference was also given to references that provided detailed treatment of established challenges for CBS (e.g., ethics, trust, etc.). For emerging subject matter (e.g., CBS processes, recent participatory decision-making methodologies), guidelines and widely agreed upon best practices documents do not yet exist, and, thus, emphasis was placed on recent, peer-reviewed journal articles summarizing emerging tools, recent attempts to implement CBS, and reflections on relevant subjects.

3.2.3 BoK Entry Creation

After using the processes above, the entries provided in the remainder of this report were created. The entries below resemble the fields in the Access database, with some modifications. These modifications were performed to remove extraneous information that is not expected to be helpful for a practitioner reviewing this report (but may be useful for categorization and keyword searches performed in the database and configuration management related to earlier steps in the BoK compilation process). For each high-value reference described in Chapters 4-9 below (i.e., each BoK "entry"), the following standard content and structure were used:

- Full reference information (**bolded** for emphasis);
- Type of Document (e.g., book, workbook, journal article, etc.);
- Document Summary (brief overview of document purpose and objectives within context of relevance to CBS—not equivalent to document abstract);
- Document Limitations (any temporal, geographical, or contextual limitations that exist for the document);
- Relevant Portions (summary of section/chapter numbers, page numbers, table/figure numbers where the most relevant content can be found); and

- Relevant Key Points (summary of overarching key points that can be gleaned from document).

The content added under each heading was written by the creators of the BoK—tailored to the purpose and aims of the BoK. Thus, the content under each heading is unique to this BoK (unless otherwise specified); for example, the "Document Summary" for a journal article is not equivalent to the article's abstract. We acknowledge that this approach intentionally introduces some subjectivity (albeit based on our own subject matter expertise)—to provide CBS practitioners with what the authors believe to be the most relevant content from each document. It is the authors' intention that the provided information meets the definition of a BoK provided in Section 1.1, specifically by "providing just enough information about each document to convey a sense of its content and purpose relative to the BoK domain."

3.3 Conclusions

The remaining chapters of the BoK present summaries of the high-value references identified via the process described above. A full list of references reviewed as part of BoK development (including those reviewed that were not deemed to rise to a level of importance to be documented as an entry in this BoK) will be made available upon request.[24]

[24] Requests can be submitted to megan.e.harkema@vanderbilt.edu.

Chapter 4: Best Practices for Risk Communication and Engagement

written by Megan Harkema

4.1 Background

As described in the Preface to this report, numerous definitions of "consent" have been developed for application in a multitude of settings, and in the context of siting a federal CISF, the definition of consensus may well be community specific. When examining definitions of "consent," "consensus," "agreement," etc. in aggregate, a pervasive theme emerges—that the group or individual agreeing to the action should be informed of the risks, and benefits, associated with the decision in question. So, how does a person or organization seeking to build consensus go about providing decisionmakers with accurate, impartial information that allows for an informed decision to be made? This is where the discipline of risk communication comes in—making it an essential element of a collaboration-based approach to radioactive waste management facility siting.

The hazards and risks associated with modern life have led to the development of the discipline of risk communication (and a corresponding multitude of handbooks, guidebooks, and other directives) over the past several decades. Even so, ambiguities and misconceptions exist in both the definition and practice of risk communication as it is understood by the public and subject matter experts alike (Árvai, 2014). Thus, we begin by adopting the 1989 National Research Council definition of risk communication — "an interactive process of exchange of information and opinion among individuals, groups, and institutions" (National Research Council, 1989) that can serve various communication functions, including care communication (risk communication for which the hazards and means of management are well understood and generally accepted), consensus communication (risk communication with the goal of informing and encouraging groups to reach a decision about risk management, and our focus in this chapter), and crisis communication (emergency communication in the face of "extreme, sudden danger") (Lundgren & McMakin, 2018).

Previously, consensus risk communication (which we refer to as "risk communication" for the remainder of this chapter) was undertaken by technical experts providing one-way messages on the risks of certain activities or decisions, and successful risk communication was viewed as public acceptance of the views of

the experts. Still today, the practice of risk communication by industry and government alike often follows this reductive framework (Kasperson et al., 2022), even though it has been well-documented that "changing" the risk perceptions of an individual or the public is difficult and is rife with ethical pitfalls (e.g., see Slovic (2000), Kasperson (2014), and Hart (2014)). In the words of Árvai (2014), "Risk is a concept that needs to be *understood* – by lay people and experts alike – not *corrected*." However, this does not mean that the tasking of risk communicators is completed when risks have been "understood," as research (e.g., Fischhoff (2012) and Kahneman (2011)) has shown that the processes and heuristics employed by individuals to make complex risk decisions tend to be decoupled from more or better information and education (Árvai, 2014), and that risk communicators should provide decisionmakers with the tools and skills required to make informed decisions (which we discuss further in Chapter 5).

For successful risk communication today, it is important that we recognize and embrace the feedback loop that exists between risk communicators (who may or may not be the designated subject matter expert) and the public, consistent with the 1989 National Research Council expectations and definitions. It is no longer sufficient to simply educate the public on predefined risk assessments, rather we should adhere to the emerging "gold standard" of risk communication—encouraging the public to provide input to risk communicators and subject matter experts in a way that involves them in the process and influences the methods, assumptions, and outcomes of risk assessment. When viewing risk communication in this frame of reference, we find ourselves with an opportunity to mobilize public knowledge and perspectives to improve the way that risk assessments are performed and risk management decisions are made (Árvai, 2014).

4.2 Key References

Although the practice of risk communication is still evolving in some ways, the key references provided in the remainder of this chapter summarize best practice methods for risk communication in a variety of modalities and contexts. These references tackle many of the recognized difficulties associated with risk communication, including, but not limited to, the ethics of risk communication, communicating uncertainties to the public, and visualizing and comparing quantitative risk information. These references are not specific to an individual industry or organization but have been selected for their relevance to the task at hand—informing the CBS process.

4.2.1 Lundgren & McMakin (2018)

Citation: Lundgren, R.E., & McMakin, A.H. (2018). Risk Communication: A Handbook for Communicating Environmental, Safety, and Health Risks, Hoboken, NJ: John Wiley & Sons (IEEE Press).DOI: 10.1002/9781118645734

Type of Document: Book

Document Summary: This book provides a wholistic understanding of objectives, methods, complexities, and constraints of risk communication in three contexts—care communication, consensus communication, and crisis communication. Part I provides information on the theories and practices underlying risk communication. Part II describes the planning and preparations that go into risk communication efforts. Part III provides guidance on risk communication methodologies, while Part IV describes how to evaluate the effectiveness of risk communication and the development of success metrics. Part V provides an overview of special cases in risk communication, including emergencies, public health campaigns, and international risk communication.

Document Limitations: Overall, highly useful reference laying out the framework for successful risk communication. However, content is intended to be applicable to a wide range of risk communication practitioners in various contexts, thus information on care communication and crisis communication may not be immediately applicable to the CBS Consortia.

Relevant Portions:

- Chapter 5: Ethical Issues Surrounding Risk Communication
- Chapter 6: Principles of Risk Communication
- Part II: Planning the Risk Communication Effort
- Part III: Putting Risk Communication into Action within various contexts, including information materials (Chapter 13), visual representations of risk (Chapter 14), face-to-face communication (Chapter 15), stakeholder participation (Chapter 17), technology-assisted communication (Chapter 18), and social media (Chapter 19). Chapters in Part III are followed by a checklist for the modality of risk communication discussed.
- Resources section (starting on page 489) includes a dedicated category on “Consensus Communication Resources.”

Relevant Key Points:

- Successful risk communication requires that risk communicators have a wholistic understanding of the landscape of risk communication principles, approaches, and pitfalls, which are thoroughly described throughout the book.
- Risk communication requires extensive, audience-specific preparation. An understanding of your audience and message can help to determine the appropriate methods to be used for risk communication.

4.2.2 Johnston & Taylor (2018)

Citation: Johnston, K.A., & Taylor, M. (eds.). (2018). The Handbook of Communication Engagement, Hoboken, NJ: John Wiley & Sons. DOI: 10.1002/9781119167600

Type of Document: Book

Document Summary: This book "conceptualizes and operationalizes engagement advancing psychological and behavioral dimensions at the individual level and extrapolating these as group-level influences at social levels relevant to organizations and societies, to provide a comprehensive examination of engagement theory and research to advance current thinking in engagement theory, strategy, and practice."

Document Limitations: This book is primarily concerned with public engagement through the lens of public relations practitioners and organizations; however, many of the best practices and concepts presented are translatable to risk communication generally.

Relevant Portions:

- Measures of Engagement—Three Tiers (within Chapter 1)
- The Conflation of Communication, Voice, and Speaking (within Chapter 9)
- Exemplars, Models, and Methods for Moving Forward (within Chapter 9)
- Discussion and Conclusion—Lessons for Engagement (within Chapter 9)
- Social Impact and its Assessment (within Chapter 12)
- Relational Community Engagement (within Chapter 12)
- Episodic Community Engagement (within Chapter 12)

Relevant Key Points:

- Chapter 1 provides an overview of the emergent themes of the book and provides measures of engagement/engagement outcomes that may help craft key performance indicators for CBS.
- Chapter 9 focuses on the need for organizational listening and provides resources and insights for larger-scale listening.
- Chapter 12 describes two forms of community engagement (episodic and relational) and provides insights and warnings when practicing each form. Chapter 12 also provides a description of the social impact assessment process, which can be used at an organizational level to understand the social consequences of decisions/behavior.
- Chapter 13 provides an overview of the state of knowledge and best practices in conflict resolution.

4.2.3 Heath & O'Hair (2009)

Citation: Heath, R.L., & O'Hair, H.D. (2009). Handbook of Risk and Crisis Communication, New York, NY: Routledge. DOI: 10.4324/9780203891629-2

Type of Document: Book

Document Summary: This book addresses risk and crisis communication in both the commercial and governmental sectors from the perspective that risk and crisis communication should be prepared and planned for concurrently. Section I of the book describes the concepts of risk and risk communication, provides a brief history, and lays out high-level insights and precautions for risk communication. Section II describes key constructs, strategies, models, theories, ethics, etc. underlying risk and crisis communication. Section III provides specific examples of risk and crisis communication in different contexts including, for example, health communication and environmental communication.

Document Limitations: Limitations include: (1) an emphasis on risk communication (and more specifically crisis communication) in the commercial sector, which may have different objectives than risk communication in relation to CBS, as evident in the definition of risk communication adopted by the book ("The ultimate goal of risk communication is to assist stakeholders and the

public at large in understanding the rationale for a risk-based decision…"); and (2) the publication date—which predates many modern calls for the reform of risk communication practices.

Relevant Portions:

- Chapter 4: Risk Communication: Insights and Requirements for Designing Successful Communication Programs on Health and Environmental Hazards
- Chapter 7: Strategies for Overcoming Challenges to Effective Risk Communication
- Chapter 17: Ethical Responsibility and Guidelines for Managing Issues of Risk and Risk Communication
- Chapter 18: Linking Public Participation and Decision Making through Risk Communication

Relevant Key Points:

- Figure 4.1 and Table 4.1 provide easily understandable depictions of topics relevant to risk debates, their complexity and levels of concern, communication needs, and evaluation criteria.
- Chapter 7 provides a bulleted list of strategies for overcoming challenges to effective risk communication associated with:
    - Selective media reporting (further detailed in Appendix E to Chapter 7);
    - Psychological, sociological, and cultural factors that create public misperceptions and misunderstandings about risks (further detailed in Appendix F to Chapter 7); and
    - A list of selected readings regarding strategies for overcoming challenges to effective risk communication.
- Appendix A to Chapter 7 provides a list of elements of a comprehensive risk and crisis communication plan.
- Appendix D to Chapter 7 provides a checklist to evaluate the quality of risk numbers and information that may be relevant to the public and that should be provided to journalists.
- Table 18.1 provides a ranking of common public participation processes according to the extent to which they provide opportunities for public involvement and deliberation with surveys and decision-aiding initiatives/forums/workshops at the extrema.
- Chapter 18 provides a four-faceted approach to improving the quality of participatory risk management approaches: (1) carefully defining the decision; (2) clarifying participants'

objectives; (3) creating management alternatives so participants can distinguish between means and ends objectives; and (4) providing participants with the information and resources to perform detailed analyses to support alternatives selection and tradeoff decision-making.

4.2.4 EPA (2007)

Citation: U.S. EPA. (2007). Risk Communication in Action: The Risk Communication Workbook, EPA/625/R-05/003. Washington, D.C.: U.S. Environmental Protection Agency. [Online] Available: https://nepis.epa.gov/Exe/ZyNET.exe/60000I2U.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C06thru10%5CTxt%5C00000001%5C60000I2U.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

Type of Document: Report

Document Summary: This document provides guidelines, best practices, and descriptions of resources to perform risk communication. Risk communication concepts are described based on perceptions, value differences, persuasion, and presentations of factual material. Descriptions of communication tools and techniques are also provided. Included are sample documents from the U.S. EPA demonstrating how the agency has employed risk communication as well as case studies and workbook exercises.

Document Limitations: This document was prepared for use by the U.S. EPA and can be used to address a number of environmental risk communication issues—thus is it not specific to risk communication issues in a nuclear context.

Relevant Portions:

- Chapter 4: Basic Concepts of Successful Risk Communication

- Chapter 7: Public Participation Tools and Techniques for Risk
- Chapter 8: Workbook

Relevant Key Points:

- Chapter 4 provides a description of the basic concepts for successful risk communication that can be used to both plan risk communication efforts and inform metrics for evaluating the success of risk communication.
- Table 4-1 provides a "Checklist of Do's and Don'ts for Spokespersons Communicating Risks."
- Chapter 7 describes categories of tools for communicating risks, including awareness tools, knowledge tools, decision-making tools, and implementation tools.
- Chapter 8 provides workbook exercises that can be used as a form of training in risk communication.

4.2.5 Kasperson (2014)

Citation: Kasperson, R. E. (2014). Journal of Risk Research, 17(10), pp. 1233–1239. DOI: 10.1080/13669877.2014.900207

Type of Document: Journal Article

Document Summary: The paper is critical of the field of risk communication at the time of its publication and seeks to answer questions on: what new risk communication experience has been gained since the 1989 National Research Council report; how uncertainty is and can be better handled; how the declining public "trust reservoir" can be handled; and what lessons can be learned from the prior three.

Document Limitations: This paper is fairly broad in scope, rather than focusing solely on siting facilities for the management (or disposal) of radioactive material.

Relevant Portions: Entire Article

Relevant Key Points:

- Future risk communication efforts, in the face of shifting societal expectations, should seek to communicate over longer timeframes with greater ambition and resources.
- The scoping of risk communicators should expand and integrate the values and cultural structures of stakeholders, with analysis specifically targeting these issues.
- Risk communicators should recognize the unique challenge posed by high-uncertainty risks, adapting their approach and expectations to best address the challenge. Specifically, standard scientific methods of expressing uncertainty will need to be tailored to the needs of stakeholders.
- Low-trust environments should be approached with a two-way communication framework, allowing stakeholders greater involvement in decision-making and how the whole siting process proceeds.

4.2.6 Tuler & Kasperson (2014)

Citation: Tuler, S.,& Kasperson, R. (2014). Social Distrust and its Implications for Risk Communication, in: Effective Risk Communication, pp. 91-107. DOI: 10.4324/9780203109861-7

Type of Document: Book Chapter

Document Summary: This chapter uses nuclear waste management as an example to discuss broader issues of risk communication in low public trust environments.

Relevant Portions: Full chapter. Of note: Figure 6.2.

Relevant Key Points:

- Trust (as expectation of intentions) and confidence (as reliability of outcomes) are distinct-but-related factors that both need to be considered in risk communication.
- Eroded social trust in the U.S. will be difficult to reverse, due to social differences causing trust-building to vary by demographic, difficulty in changing negative views, and an incomplete understanding of how trust is lost and built. However, institutions can work in low-trust environments.
- There are several dilemmas in risk communication for waste management: closing decision-making in an environment of low trust can breed worse trust; transparency can improve trust but revealed issues may reduce confidence; institutional consistency can

improve trust/confidence but reduce the flexibility needed for trust; agreement requirements and stakeholder vetoes may improve trust but cause major delays; and flexibility derived from generality in requirements can reduce confidence.

- Recommendations for working in low-trust situations include using staged and flexible processes, involving social scientists in developing risk communication strategies, ensuring analysis and communication are simultaneous and two-way, developing criteria early and with public input, bringing in external validation and assessment, and involving/partnering with communities through partnerships and granting them decision-making power.

4.3 Summary Observations

When examining the above references in aggregate, key themes emerge and can be used to craft summary observations relevant to the implementation of risk communication as part of a CBS process to site a federal CISF. These summary observations are provided in Table 3 below.

Table 3. Emergent themes in risk communication literature, with summary observations for DOE's CBS Consortia.

Emergent Theme	**Summary Observation for CBS Consortia**
Many previous efforts in waste facility siting have exhibited failures due to unilateral downplaying of local concerns (e.g., distrust of authorities, site analysis, representation) in favor of 'scientific education' that has provoked backlash.	Practitioners should be careful to not fall into the attitude that risk communication is based on the "correction" of stakeholder attitudes.
Planning for risk communication is essential, and should account for the values, histories, and demographics of audience(s) in question and the overall goal of the communication effort. Sufficient time should be allotted for these preparations and planning efforts.	Sufficient time and resources should be allocated to planning for public engagements, particularly those that entail communicating risks. Refer to the references in Section 4.2 for methods, checklists, and metrics to successfully plan for risk communication activities.

Emergent Theme	Summary Observation for CBS Consortia
Risk communication should be a participatory activity—however, participation can take various forms. Selecting the appropriate risk communication methods and tools requires familiarity with the utility and pros and cons of available participatory tools and methods.	The rationale for the selection of risk communication methods and tools used during community engagements should be founded on sound logic and documented accordingly. Method selection should not be rationalized based on preconceived notions or past familiarity with a specific method or tool. If necessary, outside subject matter expertise on the appropriate tools for a risk communication effort should be sought.
Achieving successful risk communication requires a foundation of trust between project managers, subject matter experts, risk communicators, and the public.	Building and maintaining trust is a critical element of all project lifecycle stages for the CBS Consortia. Thought should be given to trust building and maintenance from the initiation of a risk communication activity.
Crisis communication is a critical aspect of risk communication and requires similar levels of preparation and planning as other risk communication efforts.	The definition of a “crisis” may be different during CBS—perhaps related to events that involve a loss of public trust; however, crisis communication strategy can be a tool in building trust and informing the negotiations process.

Chapter 5: Participatory Decision-Making Methods, Tools, Frameworks, and Best Practices

written by Megan Harkema and Catherine Knox

5.1 Background

The main goal of practicing CBS is reaching a community consensus on the mission, location, and, frequently, the facility design. But how does one go about reaching community consensus in light of the controversial nature of radioactive waste management facility siting? Regardless of specific definitions of consensus, agreement and other related terms, participatory decision-making methods, tools, and frameworks allow for a potentially interested host community to dialogue and deliberate with each other to reach agreement on not just "yes" or "no" siting questions, but on their visions for their communities, desired benefits, perceived risks, etc. Relevant to DOE's current siting efforts, we note that a CISF's mission may not be limited to storing SNF. For example, some have posited that such a facility could be co-located with other elements of the nuclear fuel cycle to create nuclear hubs that result in synergistic community benefits (Forsberg et al., 2022). Participatory decision-making methods allow communities to explore these options to ensure that a community reaches an *informed* decision for a facility mission that aligns with their values and long-term visions for their communities.

Participatory decision-making methods can take a variety of forms. For example, in long-term environmental management contexts, CABs (also referred to as community advisory boards, site-specific advisory boards, and a host of other, similar names) can be a means for communities to provide input on long-term cleanup goals and emergent decisions that arise along the way. On the other end of the spectrum exists a variety of short-term participatory decision-making methods that can be performed on large or small scales and in traditional (i.e., in-person) environments or on web-based platforms. In still other contexts, it may be important to integrate local knowledges into the technical processes and analyses performed as part of safety analysis and structures, systems, and components decision-making.

Because of the wealth of resources and perspectives available on participatory decision-making, we do not suppose this BoK can comprehensively cover every possible method, tool, framework, or best practice. However, in this chapter, we identify some of the most recent works summarizing best practices and promising methods that can be considered for application as part of CBS.

5.2 Key References

The following subsections contain key references on the subject of participatory decision-making methods for consideration as part of CBS. These methods are not limited to prior application within the nuclear industry.

5.2.1 NRC (2020)

Citation: U.S. NRC. (2020). Best Practices for Establishment and Operation of Local Community Advisory Boards Associated with Decommissioning Activities at Nuclear Power Plants, A Report for the Senate Committee on Environment and Public Works and the House Committee on Energy and Commerce. Washington, D.C.: U.S. Nuclear Regulatory Commission. [Online] Available: https://www.nrc.gov/docs/ML2011/ML20113E857.pdf

Type of Document: Report

Document Summary: This report was prepared in response to Section 108 of the Nuclear Energy Innovation and Modernization Act (NEIMA), which required the NRC to "submit to Congress, and make publicly available, a report identifying best practices with respect to the establishment and operation of a local community advisory board to foster communication and information exchange between a licensee planning for and involved in decommissioning activities and members of the community that decommissioning activities may affect." The report summarizes lessons learned from CABs, associated with decommissioning nuclear power reactors, which were established before NEIMA. The NRC held 11 public meetings in support of the development of this report to gain insights from communities hosting commercial decommissioning activities that use CABs as part of the decision making process. The report uses the collected public comments from these meetings to identify overarching themes across CABs and as a foundation to develop circumstance-specific CAB considerations.

Document Limitations: Report is specific to decommissioned or being decommissioned commercial reactor sites and thus may not fully present considerations for CABs associated with CBS of new facilities.

Relevant Portions: Entire report

Relevant Key Points:

- 11 overarching themes for CABs were identified:
  - The complex, socio-technical issues associated with decommissioning nuclear power plants motivate early considerations of CAB formation;
  - Charter development dictates CAB authority—greater consideration of lifecycle activities in the initial charter can allow for streamlined adaptation and responsiveness;
  - Community input is essential to CAB establishment and operation, and local preferences for engagement and community concerns should be acknowledged and given consideration;
  - Membership composition should be representative of the community in question[25];
  - Community opinions on licensee membership/participation in a CAB are mixed, with the exception that the licensee should be expected to provide a baseline level of opportunities to engage (e.g., site tours, open houses, etc.);
  - Meeting frequency should account for site-specific decommissioning activities and engagement preferences of the surrounding community;
  - Public engagement needs to consider opportunities to improve public participation (e.g., meetings can be recorded or livestreamed, and newsletters, websites, and annual reports can supplement traditional meetings);
  - Dedicated funds for CAB operations (including logistical and administrative funding) need to be provided;
  - Access to training and independent technical experts is vital to CAB effectiveness. Opinions on the source of CAB funding vary;
  - CABs tend to discuss a similar list of topics including site-specific SNF storage and transportation issues, NRC regulatory filings, facility hazards and environmental considerations; and

[25] And consider both demographics and technical expertise.

- Some commenters suggested that multiple CABs (with clearly defined roles and charters) may be of more value than a single CAB tasked with advising on all decommissioning decisions.

5.2.2 Quinn et al. (2014)

Citation: Quinn, E., Huckel-Schneider, C., Campbell, D, Seale, H., & Milat, A. (2014). BMC Public Health. DOI: 10.1186/1471-2458-14-443.

Type of Document: Journal Article

Document Summary: Knowledge exchange portals (KEPs) are online tools which have been used to facilitate knowledge management in the public health sector. In this article, a review is conducted to better understand the efficacy and contributions of KEPS to inform future developments in this field. The review included analysis of literature to answer the following questions pertaining to the public health field: 1) What are the common knowledge management design features of KEPs? 2) How can KEPs assist in knowledge management for professionals? 3) Have KEPs been effective in terms of their uptake and facilitation of knowledge management? This article reviews 15 studies related to KEPs. The common design features of KEPs are explained. The results included some evidence that the "use of a knowledge exchange portal in combination with tailored and targeted messaging" can increase decision-making effectiveness at an organizational level. The article discusses that KEPs cannot account for complex factors that challenge decision making such as organizational culture, leadership, or workforce skill development. Therefore, more performance-based evaluation studies are needed to clearly show how KEPs can support evidence-informed decision-making in the future.

Document Limitations: This document reviews literature which pertains to KEPs ability to facilitate knowledge management strictly in the public health sector.

Relevant Portions:

- Knowledge access (p. 4)
- Knowledge transfer and exchange (p. 4)

- Have KEPs been effective in terms of uptake and/or facilitation of knowledge management? (p. 5)

Relevant Key Points:

- KEPs are one of many tools that can facilitate transfer of knowledge online and may be effective at promoting evidence-informed decision-making when paired with other knowledge management strategies.

5.2.3 Klein (2007)

Citation: Klein, M. (2007). How to Harvest Collective Wisdom on Complex Problems: An Introduction to the MIT Deliberatorium. DOI:10.13140/RG.2.2.32743.24489

Type of Document: Report

Document Summary: The purpose of this technical report is to propose a solution for decision-making difficulties in large communities. The proposed solution is to implement a large-scale argumentation system using an online forum. The article highlights the advantages and downfalls of social media in facilitating online discussions. A deliberation map, a hierarchical network of social media posts summarizing ideas/solutions and arguments for or against a single key issue, is proposed as a tool to transcend limitations (e.g., disorganization, conflict, etc.) and realize the benefits of using social media to aid in decision-making. The article claims that the simple structure of a deliberation map will reduce redundancy and clarity. The paper explains a proposed working structure similar to the MIT Deliberatorium, defines the user's role when using this tool, and provides case studies where this tool has been employed. This article identifies a huge potential for large-scale argumentation systems to aid in making quick and educated decisions based on a breadth of knowledge.

Documentation Limitations: This technical report provides examples of large-scale argumentation settings facilitating discussions on a large scale, and entirely online. There is no evidence of the efficacy of this decision-making model at a local level.

Relevant Portions:

- Emergent positive and negative phenomena with social media technologies (p. 2)
- Topic-centric vs. Question-centric tools (p. 4-5)
- A Solution: Large-Scale Argumentation (p. 5-7)
- How Well Does Large-Scale Argumentation Work? (p. 8-13)

Relevant Key Points:

- A large-scale argumentation system is an effective tool in providing a broad overview of proposed issues and diverse solutions with less effort than conventional social media. A community could use a platform like the MIT Deliberatorium to guide conversations and ideas pertaining to an issue but should act in favor of their own needs when necessary.
- The translation of online information into a deliberation map significantly improves information organization and access to aid in decision-making.

5.2.4 Diaz-Maurin et al. (2021)

Citation: Diaz-Maurin, et al. (2021). Science of The Total Environment, 777(146086). DOI: 10.1016/j.scitotenv.2021.146086

Type of Document: Journal Article

Document Summary: The purpose of this article is to offer insight on the preparation of stakeholder engagement activities on SNF management using the socio-technical multi-criteria evaluation (STMCE) approach. The STMCE approach involves a multi-criteria evaluation that ranks alternatives in ordinal order according to a set of criteria measurements, along with a social impact analysis that determines how each option outranks the others based on its social implications. The STMCE approach has objectives to increase the perspective pool through bringing various social actors into the analysis, supporting host communities by offering tools to compare spent fuel management strategies, searching for compromise solutions through a coalition formation process, and reallocating power amongst parties involved using a veto principle. An application of this method was conducted using data from the decommissioned San Onofre Nuclear Generating Station (San Onofre) in California. This example shows that the implementation of the STMCE approach could influence commercial SNF management by transitioning the focus on decision-

making from a national level to the levels of municipalities, Tribal Nations, states and groups of states, which is consistent in DOE's dealings with WIPP and the CBS program.

Documentation Limitations: The STMCE tool has only been tested in the context of the San Onofre example and has not yet been applied in other real-world scenarios. The approach is specifically designed for local and state level decision-making and may not be appropriate for national level issues. Additionally, the STMCE tool might not be perceived as authoritative outside of theoretical or pilot applications. There is also a learning curve associated with the tool, requiring social actors to become familiar with its use. This paper does not explicitly discuss the CBS approach proposed by the federal government.

Relevant Portions:

- Four objectives of STMCE:
  (1) Increasing the pool of perspectives (p. 2)
  (2) Supporting host communities (p.3)
  (3) Searching for compromise solutions (p. 3)
  (4) Reallocating power among parties (p. 3)
- Section 2: Framework and methods (p. 3 – 5)
  - Section 2.1 Framework (p. 4)
  - Section 2.2 Method Selection (p. 4)
  - Section 2.3 Main Features (p. 4)
- Section 3: Material and data (p. 5)
- Section 4: Results (p. 7-8)

Relevant Key Points:

- Section 2. Framework and methods show the specific features of STMCE such as compensation, importance coefficient, mixed information, simplicity, etc. which are integral to problems with conflict analysis and management in environmental and public policy decisions.
- Section 3. Material and data, describes the method for using the STMCE approach to transition stakeholder engagement and decision making from the national level to municipalities for spent fuel management, specifically at San Onofre.

- The STMCE approach could be useful for the selection of sites for managing (or disposing) of radioactive material, the selection of remediation approaches for radioactively contaminated soils or structures, comparison of deep geologic repository performance in different geologic settings, and selecting new nuclear fuel designs and advanced reactor types.

5.2.5 Westra et al. (2023) and Maheras et al. (2023)

Citations:

Westra, H., Maheras, S.J., Uribe, J., Johnson, R., Miller, G., Ikenberry, T., Spencer, Q. (2023). Prairie Island Indian Community Transportation Dose Assessment -- Building the Process, PNNL-SA-184984, Proceedings of the 20th International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM 22), 11-15 June 2023, Juan-les-Pins, France. (link unavailable)

Maheras, S.J., Westra, H., Uribe, J., Johnson, R, Miller, G., Ikenberry, T., Spencer, Q. (2023). Prairie Island Indian Community Transportation Dose Assessment -- Conducting the Assessment, PNNL-SA-184985, Proceedings of the 20th International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM 22), 11-15 June 2023, Juan-les-Pins, France. (link unavailable)

Type of Document: Conference Proceedings

Document Summary: These two conference proceedings describe the collaborative process undertaken by DOE's Office of Integrated Waste Management and the Prairie Island Indian Community to conduct a dose assessment for the rail transport of SNF from the Prairie Island Nuclear Generating Plant, which is expected to pass through the Prairie Island Indian Community Reservation and Trust Land. Westra et al. (2023) describes the participatory decision-making process used to determine radiation dose assessment locations—incorporating input from the Prairie Island Indian Community. Maheras et al. (2023) describes the technical results of dose assessments performed in concert with the Prairie Island Indian Community.

Document Limitations: Singular case study describing an example of community participation in risk assessment and decision-making, most of which is detailed in Westra et al. (2023).

Participatory methods used are not given detailed discussion—emphasis is on locations selected for radiation dose measurements.

Relevant Portions:

- Page 3 (Westra et al., 2023): Exposure Assessment

Relevant Key Points:

- These papers demonstrate that collaborative efforts between Tribal Nations and DOE can be used to structure, execute, and make decisions related to radiological risks associated with commercial SNF management (see section 2.7.2).
    - For example, based on community input, these papers perform radiation exposure assessments to bison that live in paddocks near the SNF rail transit line.

5.2.6 Rossignol et al. (2014)

Citation: Rossignol, N; Parotte, C.; Joris, G.; & Fallon, C. (2014). Journal of Risk Research, 20(10), pp. 1253-1274. DOI: 10.1080/13669877.2014.983948

Type of Document: Journal Article

Document Summary: The article has two purposes. First the article explores windfarm siting case studies in Belgium that convey that the legal siting procedure is in itself an instrument to be used to structure decision-making processes and can contribute to frustrations and public resistance to projects. Second, a methodology called the "open process workshop" is tested to question the legal siting procedure for windfarms in Belgium. The authors argue the methodology fosters the production of innovative knowledge, mutual understanding, and collective learning between participants.

Document Limitations: The case studies and decision-making method used (open process workshop) were specifically applied to windfarm siting projects in Belgium.

Relevant Portions:

- Pages 1263-1265 (Methodology): Provides a description of the Open Process Workshop methodology used to help disentangle and deconflict stakeholder frames of reference related to the social and political dimensions of siting controversial facilities.
- Pages 1268-1270 (Discussion): Discusses how use of the Open Process Workshop methodology supported the decision-making process, produced innovative knowledge, and realized mutual understanding and collective learning.

Relevant Key Points:

- The legal procedure for siting facilities associated with socio-technical controversy should be viewed as an instrument that can be used to help structure decision-making processes.
- Innovative workshopping methodologies, such as the Open Process Workshop, can be used to foster production of innovative knowledge, mutual understanding, and collective learning between participants.

5.2.7 National Coalition for Dialogue & Deliberation (NCDD) (2014)

Citation: National Coalition for Dialogue & Deliberation (2014). NCDD Engagement Streams Framework. [Online] Available: https://www.ncdd.org/uploads/1/3/5/5/135559674/2014_engagement_streams_guide_web.pdf

Type of Document: Report

Document Summary: Serving as a vital resource database, the National Coalition for Dialogue & Deliberation (NCDD) enhances public participation and engagement processes. It provides a platform for the dialogue and deliberation community to share knowledge, inspire collaboration, and generate collective impact. The NCDD Engagement Streams Framework is a tool to guide communities in appropriate and effective community engagement for education and decision-making on various issues. Its purpose is to give clarity on different deliberation and dialogue techniques so that a user can make an informed choice on which method to use. The NCDD Engagement Streams Framework accomplishes this through two charts: the first one introduces four categories based on a user's primary intention; and the second one provides and categorizes different processes for dialogue and deliberation. Key features to using the NCDD Engagement

Streams Framework for decision-making include fairly naming and framing an issue, weighing all options, considering different positions, revealing public values, and brainstorming solutions.

Documentation Limitations: The framework provides a structure for choosing engagement methods, but it does not offer detailed guidance on evaluating the effectiveness of the chosen methods or measuring their impact on decision-making and community outcomes. Additionally, while some contextually sensitive examples are provided, the framework does not fully account for all unique cultural, social, or political contexts.

Relevant Portions:

- Decision-Making-Engagement Streams (p. 2)
- Examples of Issues & Appropriate D&D Processes (p. 3)
- Process Distinction (p. 4-7)

Relevant Key Points:

The guide highlights many relevant dialogue and deliberation processes for stakeholder engagement for a group size and situation similar to CBS:

- National Issues Forums: These forums allow citizens to deliberate, make choices, and work toward reasoned public judgment, featuring carefully framed issues presented from multiple viewpoints.
- Citizens Jury: A method where a microcosm of the public deliberates for several days before issuing recommendations.
- Deliberative Polling: Combines small group deliberations with scientific random sampling to provide public consultation on policy issues.
- AmericaSpeaks' 21st Century Town Meetings: Engage large groups of citizens using innovative technology to provide direct feedback to leaders.
- Public Agenda's Citizen Choicework: Facilitates discussions on tough choices, helping participants navigate values conflicts and practical trade-offs.
- Charrettes: A collaborative design method that involves all stakeholders in a continual feedback loop to reach a consensus.
- Consensus Conferences: Involve representative group of citizens in discussing scientific or technical issues in stages, culminating in a public presentation of conclusions.

5.2.8 Government Accountability Office (2024)

Citation: Government Accountability Office (GAO). (2024). Adopting Leading Practices Could Strengthen DOE's Engagement with Stakeholders and Governments, GAO-24-106014, Washington, D.C.: Government Accountability Office. [Online] Available: https://www.gao.gov/products/gao-24-106014

Type of Document: Report

Document Summary: In response to requests from Congress, the Government Accountability Office (GAO) performed a review of stakeholder engagement principles, policies, and frameworks in place for DOE-EM. This report summarizes the findings of this review, including: (1) leading best practices for stakeholder engagement as part of environmental cleanup; (2) an examination of the extent of DOE-EM stakeholder engagement, and factors that may help or hinder DOE-EM sites from stakeholder engagement; and (3) assessment EM's framework for guiding stakeholder engagement related to environmental cleanup across its sites.

Documentation Limitations: Report is specific to DOE-EM stakeholder engagement as part of environmental cleanup—not necessarily nuclear facility siting and operation.

Relevant Portions:

- Page 13: GAO Identified Eight Leading Practices for Engaging Stakeholders and Governments in Environmental Cleanup
- Page 27: EM Sites Identified Factors that Could Help or Hinder Their Ability to Implement Leading Practices for Engagement with Stakeholders and Governments
- Page 35: EM Headquarters Lacks a National Framework to Guide Sites' Engagement with Stakeholders and Governments

Relevant Key Points:

This report provides three overarching recommendations to DOE's Office of Environmental Management:

- DOE-EM should perform an evaluation of the operation and effectiveness of DOE's site-specific advisory boards (SSABs), including recruitment/appointment, representation, attendance, and member turnover challenges;
- DOE-EM should implement a national framework for stakeholder and governmental engagement that incorporates best practices; and
- DOE-EM should develop site/regional engagement plans to institutionalize expectations for cohesive engagement incorporating best practices.

5.3 Summary Observations

When examining the above references in aggregate, a key theme emerges and can be used to craft summary observations relevant to the use of participatory decision-making as part of a CBS process. These summary observations are provided in Table 4 below.

Table 4. Emergent themes participatory decision-making literature, with summary observations for DOE's CBS Consortia.

Emergent Theme	**Summary Observation for CBS Consortia**
A number of tools, mechanisms, and frameworks exist to support community deliberation and participatory decision-making. Flexibility is required because method selection and implementation should seriously consider community preferences.	Build flexibility into engagement and participatory processes. Additional time may be required to revise approaches based on community feedback.

Chapter 6: Reflections on the Ethics of Facility Siting and Process Rulemaking

written by Megan Harkema and Brennan Ferrington

6.1 Background

Siting and operating radioactive waste management facilities (and objectionable facilities more generally) has been characterized as one of society's many "wicked problems." (Di Nucci & Brunnengräber, 2017) These problems are defined as being "ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (Churchman, 1967) and are often associated with ethical conundrums (Di Nucci & Brunnengräber, 2017). These ethical conundrums have been widely discussed, and, in part motivate a collaborative approach to facility siting. Although many authors hold different positions on the ethical issues associated with radioactive waste management facility siting, one common theme emerges—clear-cut solutions for most, if not all, of these ethical issues do not exist. These so-called ethical conundrums can take a variety of forms, for example:

- Achieving varied attributes of justice (e.g., distributive, procedural, recognition)[26];
- Definitions of consensus and who gets a say in decision making;
- Societal power dynamics that impact the ability to reach informed consensus; and
- Process and outcome transparency.

We do not naively suppose that a BoK or even the cumulative work of the CBS Consortia can solve any or all of these ethical conundrums. Rather, we must be cognizant of these ethical issues, both known and emergent, in all that we do as members of the Consortia—from developing engagement materials, to writing papers, to interviewing community representatives. If we do this, we improve our chances of finding ways to empathize, connect, and build trust with those whom we engage, with the goal of ultimately supporting incremental progress toward achieving justice, transparency, and fairness in facility siting.

[26] See the glossary of this report for definitions of distributive, procedural, and recognition justice.

6.2 Key References

Recognizing the importance of understanding modern perspectives on the ethics of radioactive waste management facility siting, we present some of the most prominent reflections on the subject below. The articles below are not necessarily specific to siting facilities for managing (or disposing) of radioactive material. Other objectionable facilities struggle with similar siting ethical issues, and in many cases are further along in the siting process than a CISF. Thus, evaluation of the ongoing ethics conversations for these facilities may help to inform DOE's CBS process.

6.2.1 Hietala & Geysmans (2022)

Citation: Hietala, M., Geysmans, R. (2022). Journal of Risk Research, 25(4), pp. 423-438. DOI: 10.1080/13669877.2020.1864010

Type of Document: Journal Article

Document Summary: This article presents the results of a literature review on the subject of social scientific engagement with radioactive waste management between 2000 and 2019, with emphasis on the adoption (or lack thereof) socio-technical approaches toward radioactive waste management. Three dominant themes were identified and discussed based on analysis of 275 articles: (1) perceptions of the risks and benefits of facility siting tended to be "individual(ized)"; (2) moving toward participatory facility siting is generally seen as a normative good; however, implementation is difficult and does not automatically lead to successful facility siting; and (3) ethical and epistemic concerns of radioactive waste management are multi-faceted and far-reaching, but are just starting to receive attention in published academic literature, and have not yet been put into largescale "practice" in radioactive waste management. The article also observes that much of the work to-date has been "multi-disciplinary" as opposed to "interdisciplinary," and the field as a whole would benefit from transitioning to the latter.

Document Limitations: Reflections and common themes are based solely on the results of a literature review.

Relevant Portions: Entire Article

Relevant Key Points:

- A chasm-like divide exists between the social scientists and technical experts involved in radioactive waste management. Thus, a need exists to treat radioactive waste management as a socio-technical issue, requiring interdisciplinary approaches—within reason. The quality of integrating the social and technical into radioactive waste management needs also to be considered—true interdisciplinary (also referred to as "trans-disciplinary") approaches are required as opposed to multidisciplinary approaches.
- Participatory governance is considered as a normative good; however, the scope and scale of participatory processes is highly uncertain, and their success tends to be contingent on community-specific histories and "political cultures."
- The timing of socio-technical interactions between communities and technical experts have also been contested. Some authors have observed that technical questions and expertise are only brought up for public discussion after the technical solution (and the corresponding problem) have been well-defined by the commercial or governmental agency looking to site a facility in order to "reduce opposition to a predefined technical solution…without opening it up for deliberation."

6.2.2 Tuler & Webler (2023)

Citation: Tuler, S., & Webler, T. (2023). Energy Research & Social Science, 95. DOI: 10.1016/j.erss.2022.102906

Type of Document: Journal Article

Document Summary: Thie primary purpose of this article is to present key points where agreement about how to design a deep geologic repository siting process have been identified based on a small survey of policy experts using the Q method (usually such surveys use factor analysis and large samples). Four general perspectives on the factors that enhance the likelihood of achieving consent during siting success result from the empirical analysis: (1) expediently reaching a "yes" response by technically accurate risk communication—with an emphasis on a strong, accepted argument for facility safety; (2) achieve acceptance by gaining trust, including independent oversight of the process and simultaneous integrated waste management system

development; (3) empower communities to make an informed decision, regardless of whether that decision is "yes" or "no"; and (4) emphasize developing a legitimate process leading to a clear decision regardless of whether that decision is "yes" or "no." The authors address how the policy experts' perspectives emphasize principles of informed consent, including better-known themes such as self-determination, understanding, and voluntariness. Of particular interest is the authors' treatment of challenges related to decision-framing and context-definition of the problem, the need to protect the process from external pressure and coercion, and challenges raised by social distrust.

Document Limitations: Q method study includes perspectives from a small cohort—12 people, although the selected individuals have expertise in nuclear waste management policy and regulations and the study is specific to deep geologic repository siting.

Relevant Portions:

- Section 3: The Idea of CBS
- Section 5: Results
- Section 6: Discussion

Relevant Key Points:

- Section 6.1 describes how the perspectives resulting from the Q method analysis emphasize the principles of informed consent, including self-determination, (adequate) understanding, and voluntariness.
- Section 6.2 discusses how the perspectives of the study participants account for socio-political challenges associated with deep geologic repository siting, including problem definition, process independence (protection from coercion and external pressures), and social distrust.
- The study identified the following differences of opinion:
    - Who consents;
    - Whether elements of an integrated waste management program should be sited independently, or should the entire system be designed at once;
    - The timing, pathway to, and ability to withdraw consent; and
    - The importance of societal trust in the implementing organization.

6.2.3 Hurlbert & Rayner (2018)

Citation: Hurlbert, M., Rayner, J. (2018). Applied Energy, 228, pp. 1320-1327. DOI: 10.1016/j.apenergy.2018.06.054

Type of Document: Journal Article

Document Summary: This article provides a description of the trivalent approach to justice in the context of energy facility siting, presents a case study of the Chippewas of the Thames First Nation's[27] failed opposition to a pipeline expansion application, and then analyzes how the case study illustrates the adequacy (or lack thereof) distributive, procedural, and recognition justice.

Document Limitations: This article examines the three-pronged concept of justice within the context of energy facility siting, specifically a First Nation's failed opposition to a pipeline expansion in Canada and thus does not address nuclear-specific siting and energy justice concerns in the U.S.

Relevant Portions:

- Section 2: Energy Justice
- Section 3: Background and the Chippewas Case
- Section 4.4.: Energy Justice Achieved?
- Section 5: Conclusion

Relevant Key Points:

- Section 2 defines and describes justice in the context of energy facility siting, and its distributive, procedural, and recognition dimensions. The specific definitions used within this article include:
    - Distributive energy justice is defined as being "inherent in the spatial, temporal and societal aspects surrounding energy" and being informed by Rawlsian[28] principles.

[27] In Canada, Tribal Nations are most often referred to as "First Nations" or "Aboriginal Peoples." We thus maintain the use of these terms throughout this report when referencing Tribal Nations in Canada.
[28] Rawlsian principles refer to John Rawls' principles of "Justice as Fairness." (Rawls, 1958)

- The article adopts Nancy Fraser's framework of recognition justice (Fraser, 1998), which "involves the assessments of institutionalized patterns of cultural valuation and distinctiveness and the identification and removal of those unjust value hierarchies that obstruct equal respect and esteem."
- Procedure justice is defined as the "fairness in the processes of resolving disputes and allocating resources, and includes transparency, notice of hearings, adequate time for preparation, and adequate hearing of all parties' concerns that are impacted."

- In Section 4.4, the authors recognize the procedural innovations that have taken place in Canada to recognize Aboriginal rights, but suggest that deficiencies in procedural, distributive, and recognition justice still exist.
- In Section 5, the article suggests that procedural innovations that recognize the "special status of some parties to contemporary energy conflicts as a matter of justice and not as a mere expedient or an exercise in political bargaining to resolve a dispute" may be required to achieve distributive and recognition justice.

6.2.5 Gupta et al. (2024)

Citation: Gupta, K., Jenkins-Smith, H., Ripberger, J.; Fox, A, & Livingston, W. (2024). Nuclear Technology, 210(9), pp. 1754-1766. DOI: 10.1080/00295450.2023.2232647

Type of Document: Journal Article

Document Summary: Survey data from the University of Oklahoma's national nuclear surveys are used to examine public preferences related to CBS process initiation, the definition of consent, how and when consent can be withdrawn, and the importance of trust.

Document Limitations: This article is specific to survey data collected as part of the annual University of Oklahoma's national nuclear surveys. However, it is not clear that, on an annual basis, the same questions pertaining to SNF management are consistently asked.

Relevant Portions: Entire Article

Relevant Key Points:

- Survey data indicates that public preference for achieving consent requires a "direct decision-making process" and that few respondents believe consent could be provided by a proxy representative.
- Survey results indicate that many stakeholders should have a say in decision-making, with emphasis on local residents and land users.
- Although survey respondents indicate that key stakeholders should have the capacity to veto, responses were unclear in regard to the role of elected officials, particularly at the state level.
- Survey responses suggest that a threshold exists after which consent may not be withdrawn—licensing (and beginning construction).
- Trust in the experts (federal and academic) likely to be involved in the siting process varies substantially among stakeholders.

6.2.6 Stewart & Stewart (2014)

Citation: Stewart, R.B., & Stewart, J. (2014). New York University Environmental Law Journal, 21(1), pp. 1-141.

Type of Document: Journal Article

Document Summary: This 141-page journal article is a legal and policy analysis of the SNF management situation in the U.S. (current as of 2014)—offering recommendations on a path forward to address the current "impasse." The article argues for four initiatives to break this impasse: (1) concurrently support development of CISFs and initiate new repository development; (2) establish a new organization to take on SNF management and disposal in lieu of DOE; (3) concurrently establish new financing arrangements for SNF management and address current government liabilities; and (4) Congression direction to NRC and DOE (or new organization) to jointly determine the rate at which SNF should be transferred from pool to dry storage.

Relevant Portions: Entire Article

Document Limitations: This article was written in 2014—many legal decisions related to SNF management have been issued since this time. Article also presents a number of opinion-based (albeit expert legal opinion-based) recommendations for revitalizing SNF management in the U.S.

Relevant Key Points:

- Section I provides historical background on the SNF impasse in the U.S.
- Section II summarizes regulation and safety issues associated with SNF management.
- Section III reviews competing considerations (and costs) for choosing between CISFs and at-reactor SNF storage; discusses issues associated with SNF storage at decommissioned reactors; and reviews international experience with CISFs.
- Section IV discusses the history of attempts to construct CISFs in the U.S., DOE's current legal authority to construct CISFs, and potential siting challenges.
- Section V addresses private development of CISFs on private land, on federally owned land, or on land leased from the federal government.
- Section VI describes options for revising the funding framework for SNF management to achieve stable, long-term funding.

6.3 Summary Observations

When examining the above references in aggregate, key themes emerge and can be used to craft summary observations regarding the ethical concerns related to CBS. These summary observations are provided in Table 5 below.

Table 5. Emergent themes in ethics of facility siting literature, with summary observations for DOE's CBS Consortia.

Emergent Theme	**Summary Observation for CBS Consortia**
Participatory governance/decision-making/etc. as used for radioactive waste management facility siting is generally considered to be a "normative good." However, in implementation, the scope, scale, and independence of the processes themselves have been critiqued.	The CBS Consortia should look for opportunities to assess impressions of the scope, scale, and independence of prior efforts in their planned engagements—and report back to DOE on lessons learned.
Radioactive waste management facility siting is inherently an interdisciplinary, socio-technical challenge.	The CBS Consortia teams should look for opportunities to cross disciplinary boundaries during their research and address methods

Emergent Theme	Summary Observation for CBS Consortia
	they encounter to build sustained interdisciplinary, socio-technical capacity.
Although socio-technical elements of radioactive waste management facility siting are important research topics to be addressed, purely sociological advancements are also required. The sociological understanding of how individuals and communities process information, assess risks, and make decisions—especially as informed by socio-cultural environments—remains poorly understood and requires further study.	Until advancements are forthcoming, practitioners should recognize, accept, and adapt to this knowledge gap by tailoring methods to different socio-cultural climates and hedging against uncertainties (Johnson & Swedlow, 2021). It may also be necessary to approach specific research questions from a purely sociological perspective (e.g., evaluation of community acceptance or opposition based on sociological models of social movements, how communities shift from "disagreement to antagonism") in assessing the socio-cultural assumptions behind siting problems.
Several aspects of the communication and siting processes can create dilemmas in ethical practice: transparency can improve trust but decrease confidence; consistency can improve trust and confidence but appear inflexible, thus, lessening confidence-building; and generality in requirements to facilitate local input can reduce confidence.	A collaboration-based approach requires one to work within—and thus understand—the value framework of local communities. Iterative approaches informed by community input may be valuable. Real-time, community-specific characterizations of the ethics of processes may allow for timely course correction.
The long-lived hazards posed by SNF tend to subject facility siting to multigenerational risk-management concerns.	Although this theme is more relevant to repositories due to their long operational lifetime, opportunities to manage inter- and intra-generational risk considerations may also exist for a CISF, e.g., are there enduring benefits a community can expect from siting a CISF?

Chapter 7: The Role of Negotiations and Compensation in CBS

written by Henry Mayer

7.1 Background

The process of searching for radioactive waste management facility sites has shifted in recent years from a traditional "decide, announce and defend" model to one of "engage, interact, and co-operate." The choice of Yucca Mountain as the sole deep geologic repository for high-level defense waste and commercial SNF followed the former model, whereas the MRS program of the early 1990s and the current DOE effort to utilize a CBS process to locate one or more sites for a CISF is following the latter. Using negotiations to decide on economic benefits to be provided to the host community has often been helpful, and sometimes necessary, to offset the perceived risks and/or displeasure with storing or disposing of SNF at a site located away from where it was generated. These benefits can take many forms because they often need to be site-specific, and they need to be an integral part of facility siting negotiations.

7.2 Key References

Key references on subjects related to the role of negotiations and compensation in CBS are discussed below.

7.2.1 Kunreuther & Easterling (1996)

Citation: Kunreuther, H., & Easterling, D. (1996). Journal of Policy Analysis and Management, 15(4), pp. 601-622. DOI: https://doi.org/10.1002/(SICI)1520-6688(199623)15:4<601::AID-PAM6>3.0.CO;2-L

Type of Document: Journal Article

Document Summary: This paper investigates the potential use of compensation in solving the challenge of siting a hazardous waste facility where it is unwelcome. It explores and discusses the theory of compensation using a normative model of choice, the effectiveness of compensation in

practice, and the results of several survey studies on how the public responds to monetary payments when applied to different types of facilities. The authors also discuss the advantages of nonmonetary compensation, such as in-kind awards to local governments to transfer some of the benefits to affected residents.

Document Limitations: Nuclear content appears to be specific to deep geologic repositories, not a temporary, above-ground storage facility.

Relevant Portions: Entire Article

Relevant Key Points:

- The normative theory of compensation's strategy for resolving a siting dilemma begins by acknowledging that the proposed facility might impose certain negative impacts on the host community, such as economic losses, implications to human health, a decline in quality of life, and degrading of the physical environment. In offering compensation, the authors assume that the objections of local residents may be overcome if they receive benefits that are sufficient to offset the expected negative impacts. Several examples are offered in the paper where compensation had its intended effect in overcoming local opposition to proposed facilities. However, residents may view a facility as sufficiently hazardous that their opposition is not dispelled by offers of monetary payments. Accepting compensation may also provoke very strong negative reactions from others who view such an arrangement as morally wrong and equivalent to a bribe.
- Several attitude surveys have investigated the impact that compensation has on a person's willingness to accept the development of a facility at a local site. These studies show a high degree of variability in the ability of compensation to change public opinion. An example was that a positive impact of compensation on public acceptance was not achieved when the proposed facility was a deep geologic repository. This conclusion was supported in six separate studies. In none of the surveys did the introduction of benefits produce a major increase in acceptance. The authors offer several explanations for these generally negative results. One is that many residents feel that such a facility will create severe health and environmental risks.
- Compensation packages can take a variety of forms in addition to direct payments to individuals. For example, if the facility is likely to impose new health risks on the local

community, the developer can award benefits in the form of new or improved healthcare services (e.g., a new trauma unit or oncology unit at the local hospital, an expanded cadre of healthcare professionals within the community). A set of attitude surveys conducted by the authors indicate that these other forms of compensation may be more effective than monetary compensation in gaining public acceptance of a facility when its risk is perceived to be high. Providing "large grants for community facilities" or "a high-tech project with new jobs" was deemed more effective than direct payments by both samples.

- The difference in effectiveness of compensation in the case of landfills versus deep geologic repositories suggests that people will trade off "small" increases in risk for economic benefits, but not huge increases. If compensation is to be effective, the authors believe that it must be preceded by measures that lead the public to regard the facility as more benign. This implies that an essential step early in the siting process is the mitigation of facility risks.
- Compensation has proven to be effective in gaining public acceptance for siting facilities presenting a low perceived risk to the community (e.g., landfills, prisons) but has been found to have serious limitations when it comes to facilities that the public regards as particularly risky or of questionable legitimacy such as deep geologic repositories. The authors propose a two-stage siting process that recognizes the importance of regulations and safety standards (Stage I) while employing a voluntary process with compensation to address concerns with fairness and efficiency (Stage II).

7.2.2 Erickson et al. (1994)

Citation: Erickson, J.D., Chapman, D., & Johnny, R. (1994). Indian Law Review, 19(1). DOI: 10.2307/20068759

Type of Document: Journal Article

Document Summary: This paper provides a thorough review of the MRS program that was created under Subtitle C of the 1987 amendments to the 1982 NWPA (Nuclear Waste Policy Act of 1982, as amended) and the attraction that its financial grants, potentially large future revenue streams, and good paying jobs had on Tribal Nations and other communities seeking to improve their local

economies.[29] Similar to the current effort to construct one or more CISFs, the first task of the MRS program was to locate a suitable site for a facility that would provide safe and reliable management of SNF until a permanent deep geologic repository becomes available. Recognizing that some form of impact assistance would be needed to improve the acceptability of such a facility in any community chosen, the NWPA provided for,

> "*…. making annual impact aid payments to appropriate units of general local government in order to mitigate any social or economic impacts resulting from the construction and subsequent operation of any such facility within the jurisdictional boundaries of any such unit.*."

The 1987 amendments to the 1982 NWPA also (1) provide requirements on the fair distribution of aid payments—with priority given to units of local government and (2) stipulates that payments utilized by local governments be used for public services related to the facility.

The 1987 Amendments also created the ONWN—a federal agency working closely with the DOE, but accountable to only the President and Congress. The ONWN changed the siting criteria and procedures to one of soliciting a voluntary MRS host through negotiation with a State or Tribal Nation. Letters were sent to all state and territorial governors, Tribal and business council chairpersons, governors of Pueblos, and presidents of Tribal Nations, inviting them to apply for grants that would permit them to conduct their own independent MRS host studies. The Phase I grants were for $100,000. The Phase II-A grants offered an additional $200,000 for continued education and feasibility studies, with the Phase II-B grant offering up to an additional $2.8 million to continue feasibility studies and education outreach, enter formal negotiations, identify potential sites, and commence an environmental assessment. Thus, an applicant could receive over $3 million before the technical feasibility of a site was determined, or any formal agreement was made with the DOE. These were large amounts of money that could be used for many purposes by Tribal Nations and other communities that were seeking to improve their depressed local economies.

Upon completion of feasibility studies, the successful applicant would then enter into formal negotiations with the DOE that included the siting and operation of the MRS, as well as formulating compensation in the form of cash payments and benefits. Section 161 of the NWPA provided a

[29] Refer to Section 2.2 of the BoK for an in-depth discussion of the MRS program.

suggested Benefits Schedule that offered $5,000,000 per year to the host community before receiving the first shipment of SNF, $10,000,000 on receipt of the first shipment, and $10,000,000 per year thereafter. There was also the promise of hundreds of good-paying jobs as was demonstrated in the WIPP facility that was built by DOE in New Mexico.

The grants and long-term financial benefits attracted 29 organizations that applied for or indicated a strong interest in obtaining at least a Phase I grant, of which only three were denied for various reasons by DOE[30]. Of these, 24 were Tribal Nations and only five were local governments. None of these applicants reached the stage of beginning negotiations with the DOE before public and state government disapproval and congressional defunding put an end to the program.

Document Limitations: Document is specific to one prior voluntary siting project.

Relevant Portions: Entire Article

Relevant Key Points:

- This paper provides an extensive discussion of what some believed was a DOE initiative intended to build on a long history of radioactive activities on land belonging to Tribal Nations and leveraging Tribal sovereignty for this purpose. Local governments that showed an interest in possibly hosting an MRS facility were stopped by the requirement that the Governor of the State provide the ONWN with written approval of the local government's application for a Phase II grant. Tribal Nations, however, are sovereign entities, and thus the state cannot veto or otherwise stop them from pursuing Phase II grants and gaining the longer-term benefits of hosting such a facility.

7.2.3 Organization for Economic Cooperation and Development-Nuclear Energy Agency (OECD-NEA) (2010)

Citation: OECD-NEA. (2010). Partnering for Long-term Management of Radioactive Waste: Evolution and Current Practice in Thirteen Countries, Paris, France: OECD Nuclear Energy Agency. [Online] Available: https://www.oecd-nea.org/upload/docs/application/pdf/2020-11/6823-partnering-management.pdf

[30] Refer to Section 2.2 for additional information.

Type of Document: Report

Document Summary: The process of searching for radioactive waste management facility sites has shifted in recent years from a more traditional "decide, announce, and defend" model to one of "engage, interact, and co-operate." The new model is an approach of "co-operation or partnership between the implementer and the affected communities, involving dialogue between experts and citizens, mutual learning, and public involvement in the process of decision making." [p. 9] In 2010, the OECD-NEA published a report describing the approach to partnering that has been or is being implemented in thirteen countries, namely: Belgium, Canada, the Czech Republic, Finland, France, Hungary, Japan, Korea, Spain, Sweden, Switzerland, the United Kingdom and the United States. The report includes descriptions of WIPP and the proposed Yucca Mountain deep geologic repository in Nevada.

Document Limitations: Document is dated from 2010. Many of the subject counties, including Canada, Sweden, Switzerland, South Korea, and the United States, have made significant headway in developing and implementing CBS processes which may not be fully described in this report.

Relevant Portions:

- Overview and transversal findings (p. 9)
- The WIPP section of this report provides a broad discussion of the negotiations, agreements, and benefits obtained by the State of New Mexico and Carlsbad since WIPP was initially authorized by Congress in 1979.[31] The discussion of the negotiations and integrated compensation arrangements in the establishment and ongoing operation at the WIPP facility is particularly salient from this OECD Report on programs in 13 countries because it is the only federal deep geologic repository to be successfully sited in the United States. This compares with the often national programs that provide processes for siting facilities for managing (or disposing) of radioactive material in the 12 other countries that are discussed in the Report.

Relevant Key Points:

- A 1981 Cooperation and Consultation Agreement between the DOE and the State formalized the State's role in WIPP, which included the negotiated settlement of key off-

[31] Readers are also encouraged to review Section 2.5 of this report for additional information regarding WIPP.

site concerns, such as transportation. Funding was to be provided for necessary road upgrading, ongoing emergency preparedness and emergency response, assistance in conducting baseline health studies of residents near the WIPP site, and post-operation monitoring of the facility. A Supplemental Stipulated Agreement in 1982 added assistance for the State to obtain technical support and emergency response funding and equipment through other federal agencies and agreement by the DOE regarding direct financial or "in-kind" assistance if the State's emergency response preparedness requests are not satisfied by other federal agencies.

- The DOE also entered into cooperative agreements with Tribal Nations located in New Mexico along waste transportation corridors concerning transportation, emergency response, and outreach.
- The 1992 WIPP Land Withdrawal Act provided the State of New Mexico with the following:
    - Emergency response training and equipment: $7.9 million (~ 6.3 million).
    - Economic impact funding of $20 million (~16 million) per year (plus inflation) for 15 years (the State used the funding for highway improvement): $166.9 million (~ 133.3 million).
    - Construction of transportation relief routes around the New Mexico cities of Santa Fe, Roswell and Carlsbad: $51 million.
    - Independent evaluation (Environmental Evaluation Group): $23.4 million (~ 18.7 million).
- The largest economic impact on Carlsbad from WIPP comes from approximately 1,000 high-paying jobs that were created. More than one-quarter of the Carlsbad workforce is directly or indirectly employed by WIPP and more than one-third of Carlsbad's wages are directly or indirectly paid by WIPP.
- Carlsbad has also received many benefits from the WIPP program, including the establishment and operation of the Carlsbad Environmental Monitoring and Research Centre (CEMRC) on the campus of New Mexico State University-Carlsbad, which was funded by DOE. The CEMRC operates out of a multi-million-dollar, 26,000 square foot facility, which has environmental, radiochemistry, chemical separation, plutonium-uranium and counting, and bioassay laboratories. Washington TRU Solutions, LLC, which operates WIPP on behalf of DOE, has co-located much of its WIPP environmental monitoring staff and activities in the CEMRC facility.

- Washington TRU Solutions has offered grant writing courses to a host of educational and not-for-profit organizations located in Southeast New Mexico and helped them write successful grants that have brought millions of dollars into the region. Washington TRU Solutions and other WIPP partners have donated a large amount of excess computer and office equipment to local public schools.

7.2.4 Bergmans (2010)

Citation: Bergmans, A. (2010). International Benchmarking of Community Benefits Related to Facilities for Radioactive Waste Management, Report commissioned by International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM).

Type of Document: Report

Document Summary: The purpose of this report is to provide an overview of various community benefits that are made available for communities hosting radioactive waste facilities (which vary in nature and stage of implementation) in the eleven International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) member states (including the U.S.). Its focus is on social and economic benefits.

A different framing is used by the individual countries to refer to community benefits, leading to the use of varying terminology. In some (such as Switzerland and Germany), explicit reference is made to benefits as "compensation" or "compensatory measures," while others (such as Spain) strongly oppose such terminology, arguing that risk cannot be compensated and that the risk associated with radioactive waste management activities is considered comparable to other industrial activities. In the Nordic countries (Finland and Sweden), the impact—directly and indirectly—of the facility on the local economy is stressed as a benefit in itself. In Sweden, this led to an agreement that the Swedish Nuclear Fuel and Waste Management Company (SKB) would invest more in local (economic) development in the municipality that was not selected, than in the host community of the future deep geologic repository. In most other countries additional employment and local procurement are also referred to as immediate benefits for a host community.

It is also seen by many countries that communities willing to fulfill an essential service to the nation by hosting a radioactive waste management facility (and in particular a deep geologic repository) should have the right to added-value measures to improve their social and economic well-being. In some countries, these measures are placed primarily in the context of encouraging the acceptance of the facility (e.g., Spain: "incentives for acceptance" and Japan: "siting promotion subsidy"). In others, the focus is more on rendering aid to the community (e.g., USA: "financial assistance" and France: "promotion of the local economy").

Document Limitations: Document is specific to EDRAM member states, which include Belgium, Canada, Finland, France, Germany, Japan, Spain, Sweden, Switzerland, United Kingdom, USA. This may leave out important radioactive waste management facility siting experiences from non-EDRAM countries (e.g., Korea).

Relevant Portions:

- Chapter 2: A diverse range of contexts
- Chapter 3: Six types of community benefits

Relevant Key Points:

- Regardless of the differences in framing, there are similar mechanisms being applied in many of the EDRAM countries. Among them, a broad categorization results in six types of benefits: direct and indirect benefits from the facility itself, additional investments in local infrastructure, additional activity ("initiatives that create additional economic, social, cultural or other local activity that is not necessarily or not directly related to the facility"), specific subsidies and grants, offering support in the form of training and logistics, and setting up community funds for local development.
- At the local level, views on community benefits are determined by elements such as the presence of and familiarity with other nuclear facilities, the population density and the size of the host community and its neighbors, the relative poverty or prosperity of the host communities as compared to other communities, in the region and to the nationwide average, the centrality or isolation of the host communities in terms of geography, mobility, and political power.
- Negotiations on community benefits were found to form, in one way or another, an integral part of facility siting procedures in all EDRAM member states. This is largely

because community benefits are to a large extent site-specific, which makes it difficult to provide criteria and procedures for decision-making at a national level. However, a general framework or basic principles concerning community benefits is provided in many countries, along with examples and the timelines over which benefits are negotiated.

- The nature and scope of community benefits are primarily determined through negotiations between the project owner or manager and the host community, with the host community consisting of the host municipality and its immediate neighbors. When benefits are made available to a broader area, these tend to be determined through separate negotiations, or at a later stage in the process. The study notes that only in the U.S., would there appear to be more of a 'regional' than a 'local' approach, as benefits, and in particular financial benefits, are directed at the State and County level.
- Community benefits generally go beyond direct and indirect benefits from the facility itself. These additional benefits tend to fall under either one of the following five categories: (1) additional investments in local infrastructure, (2) additional local activity, (3) specific subsidies and grants, (4) offering support in the form of training and logistics, or (5) setting up community funds for local development.

7.3 Summary Observations

When examining the above references in aggregate, key themes emerge and can be used to craft summary observations relevant to the role of negotiations and compensation as part of a CBS process to site a federal CISF. These summary observations are provided below in Table 6.

Table 6. Emergent themes in negotiations and compensation literature, with summary observations for DOE's CBS Consortia.

Emergent Theme	**Summary Observation for CBS Consortia**
Compensation/benefits alone do not necessarily result in a successful siting process. However, compensation can help offset perceived risks with siting hazardous	Compensation should be viewed as an essential element of negotiating a successful CBS of a CISF. However, the Consortia should be cognizant of the following precautions when discussing compensation: (1) for compensation to be effective, it should be combined with mitigation of any

Emergent Theme	Summary Observation for CBS Consortia
facilities and should be viewed as key element of an overall collaboration-based approach to siting.	unacceptable risks; and (2) compensation can appear ethically ambiguous (e.g., some can view compensation as “bribery”).
Compensation/benefits can come in a variety of forms, which include direct and indirect benefits from the facility itself, additional investments in local infrastructure, additional activity, specific subsidies and grants, offering support in the form of training and logistics, and setting up community funds for local development.	Compensations/benefits packages for a future federal CISF are likely to be site-specific and should reflect the needs and values of the local community. It may be the case that variegated benefits (e.g., funding emergency response personnel/training, transportation upgrades, income/property tax reductions, etc.) will best address the concerns and needs of the community in question.

Chapter 8: Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting

written by Megan Harkema and Brennan Ferrington

8.1 Background

DOE's implementation of CBS, backed by Congress, offers an opportunity for the U.S. to advance its radioactive waste management system consistent with internationally identified best practices. However, many countries, including Canada, the Nordic Nations, South Korea, and even Australia, have a leg up compared to the United States—they have already began implementing (or attempted to implement) CBS or similar processes. Thus, the U.S. DOE has an opportunity to learn from the successes and failures of its international counterparts when developing and implementing its CBS process—and, in many ways, has already undertaken efforts to this effect.[32] Previous successes and failures should be given equal consideration for the development of the U.S. process. We have observed that much of the existing literature critiques the processes implemented by other countries. Nevertheless, these critiques may offer valuable insights to help the U.S. CBS process, and they are summarized in this chapter. The references in this chapter are presented with one caveat—experts affiliated with the BRC (Tuler & Kasperson, 2010) have questioned the applicability of lessons learned from international efforts due to differences between such countries and the United States, and their view is a motivating factor for the U.S.-centric nature of the remainder of the BoK. We thus present these descriptions and critiques of international experience with radioactive waste management facility siting with the recommendation that the political, social, technical, and geospatial differences between the U.S. and the countries described are considered while reading these documents.

[32] For example, Leslie (2024) describes that DOE has completed internal reviews of siting efforts in Canada, Switzerland, the United Kingdom, Finland, and Germany; however, DOE has chosen not to make these reviews publicly available.

8.2 Key References

The discussion of international experience is limited to four countries/regions that have made progress toward CBS since the publication of the BRC final report: Canada; the Nordic Countries, including Finland and Sweden; South Korea; and Australia. One additional reference that describes the Nuclear Waste Technical Review Board (NWTRB) perspectives on CBS—from both review of the DOE program and hosting an international workshop on radioactive waste facility siting—is provided in Section 8.2.5.

8.2.1 Canada

In 2002, Canada's nuclear electricity producers established the Nuclear Waste Management Organization (NWMO)—the organization responsible for long-term management of Canada's SNF. Canada's strategic plan for SNF management is referred to as Adaptive Phased Management (APM), with the ultimate goal of disposing SNF in a deep geologic repository. The APM process is community-driven and incorporates the voices and opinions of Indigenous Peoples (NWMO, 2024a).

8.2.1.1 Bell (2021)

Citation: Bell, M.Z. (2021). Local Environment, 26(1), pp. 165-180. DOI: 10.1080/13549839.2020.1867841

Type of Document: Journal Article

Document Summary: The article examines the ways that local contextual factors (e.g., social, economic, political dominance) can shape how a community interacts during a siting process for facilities for managing (or disposing) of radioactive material. The author suggests that the fairness and justice of such siting processes can be improved by mobilizing local knowledge to inform/shape the siting process itself. The article specifically presents a case study focused in Bruce County, ON, which is home to an existing nuclear power plant and stores 40% of Canada's SNF –the author refers to Bruce County as a "nuclear landscape" due to the economic and social impacts that nuclear has on the community itself. Bruce County was one of the NWMO's candidate sites for a deep geologic repository, for which the NWMO has used an APM process to reach

community consensus. The author specifically examines participation in community liaison/advisory committee (CLC) meetings and related events.

Document Limitations: Singular Canadian case study (Bruce County) examining siting process for a deep geologic repository.

Relevant Portions:

- Pages 170-176: NWMO Bruce County Case Study
- Pages 176-177: Conclusions

Relevant Key Points:

- The author criticizes the APM process primarily on the grounds that the vague NWMO policies that heavily rely on "community-driven shared decision-making" can reduce the procedural justice of the siting process due to local power dynamics and, in the case of South Bruce, the dominant nuclear landscape.
- The author concludes with the following recommendations for improving the NWMO process at the CLC level: (1) provide careful oversight and guidance of the process instead of devolving all decisions to the community level; (2) mobilize local, community-specific knowledge to translate policy into practice; and (3) increase the participation of critical (anti-nuclear) voices and avoid condescension when responding to such voices.

8.2.1.2 Bell (2022)

Citation: Bell, M. (2022). Nature and Space, 6(2), pp. 841-862. DOI: 10.1177/25148486221117947

Type of Document: Journal Article

Document Summary: The article builds on the concepts presented in Bell (2021) to examine how tensions between policies and their implementation impact the knowledge included and integrated into the NWMO APM process for siting a deep geologic repository. The article examines how variegated knowledges have been factored in at two communities that have opted-in to the APM process—South Bruce and Huron-Kinloss. The author of this article recognizes the benefits nature of high-level APM processes, but similar to Bell (2021), criticizes their implementation,

specifically in the dismissal of critical lay (i.e., non-expert) knowledge in communities with existing nuclear landscapes and in the representation of Indigenous knowledge.

Document Limitations: Limited scope Canadian case studies examining siting process for a deep geologic repository.

Relevant Portions:

- Pages 851-853: Case study describing dismissal of critical lay voices in Canada's APM process.
- Pages 853-857: Case study discussing NWMO incorporation of Indigenous knowledges into APM process.
- Pages: 857-858: Recommendations for improving the breadth of knowledges considered in APM process.

Relevant Key Points:

- Issues regarding the integration of Indigenous knowledge are broken into two categories—separation of Indigenous and municipal processes (which can reduce Indigenous participation and diminish the integration of their knowledge into the process) and the "scalar homogenization of Indigenous knowledges" (the idea that the knowledges of First Nations can be represented as one, when in reality community-specific knowledges need to be considered).
- The author concludes with the following recommendations for improving the NWMO APM process: (1) adopting an approach that emphasizing knowledges based on local context and relationships) through discussion panels that recognize and incorporate Indigenous and critical lay voices, with appropriate moderation/guidance; and (2) recognition that geographic context will shape the implementation of policies—and using this information to integrate a breadth of knowledges into the process.

8.2.2 Nordic Countries

Finland and Sweden are, in many cases, touted as *the* democratic models for deep geologic repository siting (Lagerlöf, 2023), and are by far the furthest along in the siting and construction processes, making the critiques and lessons learned from these countries valuable to DOE's CBS initiative. Posiva, the Finnish

organization tasked with siting and building a deep geologic repository, has constructed and licensed a deep geologic repository in Olkiluoto, Eurajoki. SKB, the Swedish company with a similar mission, has selected the location of Forsmark in the Östhammar Municipality.

8.2.2.1 Di Nucci (2019)

Citation: Di Nucci, M.R. (2019). Voluntarism in Siting Nuclear Waste Disposal Facilities: Just a Matter of Trust?, Conflicts, Participation and Acceptability in Nuclear Waste Governance, Berlin, Germany: Springer. DOI: 10.1007/978-3-658-27107-7_9

Type of Document: Book Chapter

Document Summary: This chapter in the book *Conflicts, Participation and Acceptability in Nuclear Waste Governance* analyzes the issue of siting a deep geologic repository and questions whether voluntarism can ease siting procedures by considering the activities of four countries—Sweden, Finland, France, and the UK—in the content of various CBS frameworks.

Document Limitations: Specific to deep geologic repository siting concerns and considerations; however, some of these may also be relevant to a CISF.

Relevant Portions: Entire chapter

Relevant Key Points:

- Voluntarism takes different forms based on the characteristics and type of host facility. The chapter identifies a number of different approaches to voluntarism, including incentives-based, partnership, trust-based, competitive, precarious, and passive.

8.2.2.2 Lagerlöf (2023)

Citation: Lagerlöf, H. (2023). Environmental Politics, 32(7), pp. 1255-1274. DOI: 10.1080/09644016.2023.2172867

Type of Document: Journal Article

Document Summary: This article presents a case study critiquing the use of news media to "reduce the gap between industry and community by means of 'information.'" The focus of the article is on one type of communication by SKB—the Lagerbladet magazine, which is published quarterly in Östhammar and distributed to all residents (it was previously also published in Oskarshamn until the decision was made to move forward with siting a disposal facility in Östhammar).

Document Limitations: Article focuses on siting experience in one community—Östhammar, Sweden.

Relevant Portions:

- Page 5: Problematizing Consent
- Page 9: Data and Analysis
- Page 11: Caring About Local Interests
- Page 16: Conclusions and Discussion

Relevant Key Points:

- The “Caring About Local Interests” section describes both the technical and socio-technical contents and information regularly published in Lagerbladet, and how it can be viewed in some frames of reference as problematic.
- Key conclusions include:
    - Public interests can be heavily influenced by powerful actors.
    - Three types of coercion can influence the achievement of a fair approach to siting: (1) decision-making power (overt coercion through insertion in decision-making processes); (2) agenda-setting power (disregard of contradictory social interests); and (3) influencing the wishes of subordinates. The article addresses the third element of coercion and argues that a lack of protests in a siting effort should not be misconstrued as "consent"—as this may potentially be the result of the tactics that have been used by those in power—using Östhammar as an example. The author suggests that the tactics used for coercion in this case include "reactive and proactive consent-building tactics to secure public compliance" and influence the fairness of the siting effort. However, the author does not suggest that fairness can be improved or achieved, but rather that siting procedures are "inevitably unfair."

- Finally, the author suggests that identifying and addressing critics of CBS may require looking for dissenters in new places (i.e., beyond the documented formal public participation mediums).

8.2.3 South Korea

In South Korea, the Ministry of Trade, Industry and Energy has determined that by 2028, disposal facility sites for radioactive waste from nuclear power plants need to be selected. Although South Korea has not explicitly stated its intent to use a CBS approach, the country's National Framework for the Management and Regulation of Radioactive Waste and Decommissioning (OECD-NEA, n.d.) aligns with many of the best practices associated with CBS, stating that "Radioactive waste shall be managed transparently and openly, and the radioactive waste management project shall be promoted with regard to harmony with the local community, and to community development," and thus, opportunities exist to learn from the Korean siting process.

8.2.3.1 Kim & Kim (2014)

Citation: Kim, T., & Kim, H. (2014). Applied Geography, 47, pp. 1-9. DOI: 10.1016/j.apgeog.2013.11.010

Type of Document: Journal Article

Document Summary: In 2005, the Korean government used a local referendum system, with promised economic incentives, to select Gyeongju as the city (out of four candidates) for a low-level radioactive waste disposal facility. Gyeongju was selected because the city had the highest approval rating for the facility based on the referendum. However, spatial justice problems emerged with the referendum process. For example, the referendum process caused conflict between residents who lived closer to the site of the facility but outside of the host city because they did not receive financial compensation. This article analyzes, using a mixed-methods approach, and highlights concerns regarding the spatial justice aspects of the referendum system used.

Document Limitations: Post-hoc analysis of siting efforts for Korean radioactive waste disposal facility.

Relevant Portions:

- Page 7: Discussion

Relevant Key Points:

- Six factors (economic, risk perception, political, spatial, emotional, and empirical) can influence acceptance of radioactive waste disposal facility siting.
- Acceptance levels for a facility can vary based on experience and knowledge, topography, how developed the area is, and geopolitical boundaries—a siting process and benefits package that disregards these influences may cause intra- and inter-regional conflicts, as were experienced in South Korea. Further exacerbating these conflicts can be the need for a large facility footprint, which necessitates siting in a rural area.

8.2.3.2 Kim & Park (2017)

Citation: Kim, T., & Park, H. (2017). Land Use Policy, 67, pp. 702-709. DOI: 10.1016/j.landusepol.2017.07.011

Type of Document: Journal Article

Document Summary: This article presents a method to consider the subjective perspective of residents in Korea concerning facilities managing radioactive material and identifies differences in acceptance determinants between subjective perspective types using a combined Q analysis and structural equation model analysis.

Document Limitations: Article presents a methodology for understanding public perceptions. Methodology was tested on limited subset of communities (Ulsan and Gyeongju regions) in South Korea.

Relevant Portions:

- Section 2: Materials and Methods
- Section 3: Results

Relevant Key Points:

- Four factors were found to affect resident acceptance of deep geologic repositories: environmental, economic, risk, and social.

8.2.4 Australia

After a 28-year process, Australia finally selected the Kimba site for a deep geologic repository for the disposal of low- and intermediate-level waste in July 2023. However, by October 2023, the project had been scrapped. Prior to the selection of the Kimba site for a deep geologic repository, Australia went through two previous failed attempts at siting such a facility—motivating the last such (failed) attempt to follow a collaborative process. The duration and failures of the Australian process offer an opportunity to identify insights for DOE's CBS process development and implementation.

8.2.4.1 Green (2017)

Citation: Green, J. (2017). Angelaki Journal of the Theoretical Humanities, 22(3): pp. 33-50. DOI: 10.1080/0969725X.2017.1387364.

Type of Document: Journal Article

Document Summary: This article describes in detail the first two attempts to site a deep geologic repository in South Australia (1998-2004) and the Northern Territory (2006-2014) and provides an update on a third siting process targeting South Australia. All three attempts targeted Aboriginal[33] lands.

Document Limitations: Document was published in 2017—as described in Section 8.2.4, the most recent waste storage site at Kimba, South Australia has been scrapped. Further, the key points of this article should be evaluated for bias due to the strong negative tone used in describing the actions of the Australian government.

Relevant Portions: Entire Article

Relevant Key Points:

[33] In Australia, the term "Aboriginal Peoples" is most often used to describe the Indigenous People of Australia. We thus maintain the use of the term throughout this report.

- "Systematic, bipartisan racism" has been evident in the South Australian and the Northern Territory siting attempts, and in more recent promotion of the uranium industry in Australia. However, Aboriginal voices have been an important element of campaigns to end plans for Australian national deep geologic repository sites.

8.2.4.2 Calyx & Jessup (2019)

Citation: Calyx, C., & Jessup, B. (2019). Environmental Communication, 13(4), pp. 491-504. DOI: 10.1080/17524032.2018.1464489

Type of Document: Journal Article

Document Summary: This article describes the Government of South Australia's Nuclear Citizens Jury processes, which were intended to help reach consensus on issues related to expanding nuclear involvement—including a "fuel waste storage facility." This article criticizes the processes, suggesting that it did not achieve consensus, but rather resulted in majority opposition to such a facility. The first stage of the research described in the article uses an analysis of transcripts, videos, and other outputs of the Nuclear Citizens Jury processes, bolstered by contextual socio-legal analyses. The second stage of the research involved revisiting the data within the context of the legal and geographic history of the nuclear fuel cycle in Australia.

Document Limitations: Document is current as of 2019—as described in Section 8.2.4, the most recent waste storage site at Kimba, South Australia has been scrapped.

Relevant Portions: Entire Article

Relevant Key Points:

- The Nuclear Citizens Jury did include some valuable process elements to support deliberation and decision-making, including access to resources and learning opportunities, process transparency, and objectives clarity.
- However, the Nuclear Citizens Jury process did identify challenges related to fairness, outcome transparency, and lack of independence.
- Recommendations for deliberative processes generally include increased consideration of representation, consent, and differing legal geographies.

8.2.5 NWTRB (2024)

Citation: NWTRB. (2024). Proceedings of the Board's 2023 International Workshop on Siting of Radioactive Waste Facilities. [Online] Available: https://www.nwtrb.gov/docs/default-source/reports/nwtrb_2024_proceedings-report.pdf?sfvrsn=d004c305_3

Type of Document: Report

Document Summary: This report summarizes international best practices for CBS on the outcomes of an International Workshop on Siting of Radioactive Waste Facilities held by the NWTRB in August 2023.

Document Limitations: Document is an overall summary of recent NWTRB efforts on CBS, but does not include detailed summary of the NWTRB's recent review of the ongoing DOE program (Leslie, 2024).

Relevant Portions: Entire Report (takeaways section may be particularly useful)

Relevant Key Points:

- Summary of key, common messages from international participants:
  - Success requires mutual learning and listening.
  - Organizations siting radioactive waste storage, treatment, and disposal facilities are in the "trust business," and opportunities to build trust include program continuity, well-defined processes and metrics, etc.
  - Implementers should anticipate long, multidecadal timelines to achieve CBS.
  - A CBS process should be well-defined, and socially and technically acceptable.

8.3 Summary Observations

Almost all CBS efforts across the globe have been critiqued in some way, shape, or form. Most of these critiques acknowledge the progress made by the parties looking to site facilities but emphasize shortfalls in the execution of CBS processes. Given the complexity and "wicked" nature of radioactive waste management facility siting, it is likely that any collaboration-based program will be subject to criticisms—

the best that can be hoped for is to learn from prior mistakes and try to improve upon the process. Examining the above references in aggregate offers an opportunity to identify key themes that can be used to craft summary observations regarding the critiques of international siting efforts for the CBS Consortia. These summary observations are provided in Table 7 below.

Table 7. Emergent themes in international critiques of siting efforts, with summary observations for DOE's CBS Consortia.

Emergent Theme	**Summary Observation for CBS Consortia**
Community-specific processes, tools, and participation opportunities are critical to achieving successful CBS.	Account for the preferences, values, demographics, and culture of communities when crafting engagement approaches.
Powerful actors and dominant voices can impact public decisions and perceptions—and thus the perceived fairness of the siting process.	Develop mechanisms to identify and include representative voices present in community engagements.
Dissenter voices can be important to listen to—they can help identify and address process flaws.	Consider giving dissenting voices a platform to convey their message. Use that message to identify process improvements.
Legal jurisdictions and socio-political boundaries can be sources of conflict during siting because they can influence benefits package acceptance, definition of the public(s) involved in the decision making process, justice considerations, etc.	Research and account for legal jurisdictions and socio-political boundaries when planning for engaging the community.

Chapter 9: Recommendations for Tribal Engagement

written by Megan Harkema and Brennan Ferrington

9.1 Background

As evident from past siting attempts[34], Tribal consultation is a critical element of a collaboration-based approach to siting radioactive waste management facilities in many parts of the U.S. When identifying the appropriate Tribal Nations to consult, not only is consideration of the distribution of modern Tribal lands and reservations required, but consideration of historic Tribal cultural resources is also crucial. For example, as part of the NEPA process used by federal agencies to assess environmental effects, consideration of Tribal cultural resources is required to achieve compliance with the National Historic Preservation Act (NHPA). Specific to radioactive waste management, a number of organizations have recommended that the U.S. DOE prioritize Tribal consultation as part of the siting process, including, for example:

- The BRC (BRC, 2012), who recommended consultation and involvement of Tribal Nations and Tribal governments during the siting negotiations and transportations processes;
- The Nuclear Energy Tribal Working Group (NETWG) (NETWG, 2016), who, in their 2016 report recommended that DOE "…Acknowledge Tribal Support is Vital to Ensuring Success of the Nuclear Siting Program." In implementation of these processes, the NETWG also recommended that DOE recognize and understand Tribal sovereignty, as well as the trust responsibility of the federal government, and apply consistency in its implementation of laws and policies in application to Tribal Nations;
- The NWTRB's review of the DOE Integrated Waste Management Program in March of 2023 commended DOE for its prioritization of consultation with the Tribal Nations and found this prioritization to be a positive and necessary step to achieve CBS.

The government-to-government relationship between the federal government (including federal agencies) and Tribal Nations is important to account for during the development of CBS processes, policies, and practices. This relationship is founded on the recognition of Tribal sovereignty, as well as the trust responsibility that the federal government maintains with Tribal Nations. Many mature (e.g., the DOE

[34] For example, the MRS siting effort described in Sections 2.2 and 2.3.

American Indian Tribal Government Interactions and Policy (DOE, 2009), and the NWPA (NWPA 1982)) and more recent policies and laws (e.g., the 2021 Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty and Reserved Rights)) exist that govern DOE's interactions with Tribal Nations. However, many of these policies and laws—especially the more recent ones—do not provide detailed information on the implementation of government-to-government relationships or the trust responsibility of the federal government. The CBS Consortia should look to additional resources to inform their understanding of the relationship between DOE and the Tribal Nations in support of community engagements and capacity building.

Today, in addition to remaining a unique and powerful element of the American family of governments, Tribal Nations still maintain their rich cultures and ways of life rooted in Indigenous knowledge and traditions (National Congress of American Indians, 2020). These Indigenous knowledge systems and traditions are distinctly different from their Western counterparts in how they recognize the interrelationships between all components of the environment (NWMO, 2024b) and account for intergenerational risks and benefits as part of decision-making. Thus, an opportunity exists to learn from what is termed Indigenous Traditional Ecological Knowledge (ITEK) in many references today[35] to improve the CBS process, consistent with the ethical considerations described in Chapter 6. However, engaging with Tribal Nations requires understanding of how the beliefs, values, perspectives, and ways of life differ from Western culture—and an understanding and respect for the fact that no two Tribal Nations have identical histories, knowledges, beliefs, or traditions. Thus, deep thought, humility, and thorough preparation are essential for engaging with Tribal Nations.

9.2 Key References

Key references related to recommendations for Tribal engagement are described below. The references considered include general best practices guides, a workbook to support engagement preparation and planning, and a recent summary of the status of Tribal Nations today produced by the National Congress of American Indians.

[35] We acknowledge that the term "Indigenous Traditional Ecological Knowledge" is not recognized or favored by all Indigenous Peoples today, and that terms such as "Indigenous Knowledges" or "Other Knowledges" are likely to be more accurate. We have chosen to use this terminology in limited capacity within this report to be consistent with the terminology used in the funding vehicle for this work, DE-FOA-0002575, *Collaboration-Based Siting for Interim Storage Program -- Community Engagement Opportunities*.

9.2.1 U.S. DOE (2000)

Citation: U.S. DOE. (2000). A Guide for DOE Employees Working with Indian Tribal Nations, Creighton & Creighton, Inc., Washington, D.C.: U.S. Department of Energy. [Online] Available: https://www.energy.gov/em/articles/doe-guide-working-Tribal-nations

Type of Document: Report

Document Summary: This report was written as a guide for DOE employees working with Tribal Nations as part of their jobs; it specifically focuses on providing insights to help initiate conversations with Tribal Nations and to help build/sustain working relationships. The report begins by providing a brief overview of DOE's government-to-government relationship with Tribal Nations, as well as the laws and executive orders that constitute, or have constituted, the framework of that relationship. This report also presents a general overview of the cultural differences, Tribal environmental beliefs, and Tribal etiquette that need to be understood to lay the groundwork for effectively communicating and engaging with Tribal Nations.

Document Limitations: Document is from 2000—recent considerations for interacting with Tribal Nations may not be represented. The document is geared toward DOE employees but is generally useful. Guide includes general considerations for engaging with Tribal Nations—is not specific to individual Tribal Nations.

Relevant Portions: Entire report

Relevant Key Points:

- Descriptions of DOE's government-to-government relationship with Tribal Nations can be found on:
    - Page 4 (What it means to have a government-to-government relationship) describes the process of government-to-government consultation, communication/coordination/outreach between Tribal staff and DOE employees, rules and procedures for entering Tribal lands.
    - Page 6 (What are DOE's trust responsibilities) provides a bulleted list of DOE's trust responsibilities to Tribal Nations.

- Page 8 (Building a Relationship with Tribes) provides a bulleted list of best practices for building and maintaining relationships with Tribal Nations founded on trust. Although these best practices are geared toward DOE staff, many of them are generally relevant for CBS practitioners today.

- Page 11 provides examples of potential cultural misunderstandings including, for example, the importance of schedules and time, respect for Tribal elders (regardless of position), and decision-making processes.
- A number of sections provide descriptions of cultural etiquette points to be aware of including:
  - Page 13 (Pointers on Tribal Meeting Etiquette);
  - Page 14 (Things You Need to Know About Tribal Etiquette During Cultural Ceremonies); and
  - Page 14 (Things You Need to Know About Visiting Reservations).

9.2.2 National Congress of American Indians (2020)

Citation: National Congress of American Indians (NCAI). (2020). Tribal Nations and the United States: An Introduction. Washington D.C. [Online] Available: https://archive.ncai.org/about-tribes

Type of Document: Report

Document Summary: This document provides background information regarding the history, culture, and outlook of Tribal Nations today that should be well-understood prior to initiating interactions with Tribal Nations. Specifically, the report introduces a wide range of topics about Tribal Nations, including the principles and history of the Tribal Nations and Tribal governance, the relationship between Tribal Nations and state and federal governments, and the economic conditions of Native Peoples[36] (including recent progress and lingering challenges) in the U.S. today.

[36] The term Native Peoples is used by the NCAI in its report, and thus we defer to its usage in this particular instance.

Document Limitations: Document emphasis is on historical and modern understanding of Tribal governments and economies, which is valuable background for the CBS Consortia, but document does not provide in-depth discussion of best practices for engaging with Tribal Nations today.

Relevant Portions:

- Page 10: Where Native Peoples Live
- Page 12: A History of Population
- Page 19: Tribal-Federal Agreements in the Modern Era
- Page 22: The Three Governments: Tribal, Federal, and State
- Page 25: What is Federal Recognition?
- Page 33: Government-Government Consultation with Tribal Nations
- Page 40: Confronting Decades of Challenges

Relevant Key Points:

- The document is provided as high-priority background reading prior to engagements with Tribal Nations and is not focused on process characteristics of CBS.

9.2.3 Martin et al. (2021)

Citation: Martin, T., Higgins, M., Schofield, R., Sotelo, S., Hoppe, K., Hancock, W., de Krieger, M., Schmidt, J., Thibault, M. (2021). FIRST STEPS: A Resource for Engaging with Indigenous Communities in STEM. Beyond 100K Supporting STEM Education in Tribal Communities Project. (link unavailable)

Type of Document: Report/workbook

Document Summary: This short workbook suggests ways to initiate engagement respectfully and intentionally with Indigenous entities. The report includes tips for engagement and guides users through a series of questions to better understand Indigenous perspectives and begin the journey of building trust and positive relationships.

Document Limitations: Report is specific to engaging Tribal Nations on the subject of education. No worked examples are provided to demonstrate approach.

Relevant Portions: Entire report/workbook

Relevant Key Points:

- General points to consider when identifying Tribal Nations, Tribal leaders, or Tribal members to engage are described on page 3 and include, for example, avoiding assumptions, practicing cultural sensitivity, understanding the complex, emotional, and personal context of discussion about a Tribal Nation's land base[37].
- Pages 4-9 provide lists of questions for practitioners to consider when engaging with Tribal Nations on subjects including historical perspectives, culture & tradition, land base, and education.

9.2.4 Tobias (2000)

Citation: Tobias, T. (2000). Chief Kerry's Moose: A Guidebook to Land Use and Occupancy Mapping, Research Design and Data Collection, Vancouver, BC: Union of BC Indian Chiefs and Ecotrust Canada. [Online] Available: https://fngovernance.org/wp-content/uploads/2020/06/Land_Use__Occupancy_Mapping_Guidebook.pdf

Type of Document: Book

Document Summary: This book presents a discussion of key factors that help lead to successful occupancy, land use, and cultural resource mapping of Aboriginal lands in Canada. Although the subject of Aboriginal mapping is only peripherally relevant to DOE's CBS efforts, this book provides an overview of a number of research considerations that can be extricated from the framework of "mapping" to be generally relevant to performing collaborative research with Tribal Nations. Specifically, this book addresses the following elements of collaborative research with Aboriginal Tribes: tasking, research design, quality metrics, and implementation principles.

Document Limitations: This book is specific to land use mapping research performed with First Nations and Aboriginal Peoples in Canada; however, many useful insights regarding engaging with Indigenous peoples—including those in the United States—can be inferred from discussions.

[37] Tribal land ownership is a complex issue (see NCAI (2020) for additional information). We use the term "Tribal land base" consistent with its usage in Martin et al. (2021) and NCAI (2020), but do not attempt to define it due to these complexities, other than to say that it includes both current Tribal lands and ancestral Tribal lands.

Relevant Portions:

- Chapter 2: The Tasks of a Mapping Project
- Chapter 4: Doing Quality Research
- Chapter 5: Designing the Project: Why, Who, When, Where and What
- Chapter 6: Principles of Research Design and Implementation
- Chapter 8: Creating a Culture of Research

Relevant Key Points:

- Refer to the “Summary” section of the book starting on page 58 for a list of 18 emergent recommendations.

9.2.5 NWMO (2009)

Citation: Nuclear Waste Management Organization (NWMO), (2009). Report of the NWMO Traditional Knowledge Workshop-2009, APM-REP-00660-0001. [Online] Available: https://www.nwmo.ca/-/media/Reports-MASTER/Social-reports/APM-REP-00660-0001-Report-of-the-NWMO-Traditional-Knowledge-Workshop---2009-12.ashx

Type of Document: Report

Document Summary: This report summarizes the findings of an NWMO workshop discussing the comparison and intersection between "western science" and "traditional knowledge."

Document Limitations: This report is based on a single set of documented Canadian experiences.

Relevant Portions: Entire Report

Relevant Key Points:

- Traditional knowledge may not adhere to linear causation, assumed conceptualizations of time, or assumed conceptualizations of reality. For example, understanding the ‘why’ behind the sacredness of a place or resource can be important to address, rather than just the ‘if.’ Protection of this knowledge can be important, so clear and mutually-agreed-upon data/information dissemination controls should be put in place as soon as practicable.

- Securing clear consensus and agreement at every step of the process is important, even in the earliest stages.
- Relationships that "flatten the initial power imbalance" are necessary to long-term, stable collaboration. First impressions and face-to-face interactions are vital, with careful attention paid to patience, respect, open-mindedness, and language limitations. Understanding internal power structures and leadership is necessary for an effective relationship, in addition to engagement with individuals where they are.
- Consider how the approval or disapproval of one group/demographic may affect that of another.

9.2.6. Barnaby & Emery (2008)

Citation: Barnaby, J., & Emery, A. (2008). Report of the traditional knowledge project, NWMO DR-2008-03. [Online] Available: https://www.nwmo.ca/-/media/Reports---Files/PDFs/2015/11/04/17/32/916_NWMODR-2008-03ReportofTraditionalKnowledgeProject.ashx

Type of Document: Report

Document Summary: This report describes the findings of the NWMO's "traditional knowledge project," which sought to better understand Aboriginal traditional knowledge vis-à-vis 'western knowledge'.

Document Limitations: Limited to experience with First Nations in Canada.

Relevant Portions: Entire Report

Relevant Key Points:

- In previous interactions with or solicitation of Tribal input, information has been incorporated into the fields in preexisting datasets, removing context from information and forcing it to conform to preconceived data formatting. Instead, this information should be retained and incorporated directly into decision-making and organization processes.
- Discussions with Tribal members generated several suggestions: using native-language place names, including observations from local harvesters as data for

environmental conditions, use of iterative translation by committees of language experts, use of open-ended interviews, collaborative pre-research planning, effective knowledge dissemination, incorporation of local values & decision-making, and attempts to find common ground.

- This report contains several extensive and valuable lists—namely methods of information sharing and key similarities and differences between western and Aboriginal knowledge.

9.2.7. Working Group of the Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty and Reserved Rights (2022)

Citation: Working Group of the Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty and Reserved Rights. (2022). Best Practices for Identifying and Protecting Tribal Treaty Rights, Reserved Rights, and Other Similar Rights in Federal Regulatory Actions and Federal Decision-Making, Washington, D.C.: Bureau of Indian Affairs. [Online] Available: https://www.bia.gov/sites/default/files/media_document/best_practices_guide.pdf

Type of Document: Report

Document Summary: This document provides new standards for Tribal consultation by federal agencies based on best practices identified by a working group formed by a November 2021 Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty and Reserved Rights. The report: (1) provides a summary of the existing federal policy framework for Tribal consultation and decision-making related to treaty and reserved rights; (2) provides a summary of Tribal input on consultation and decision-making related to treaty and reserved rights; and (3) urges federal agencies to review their Tribal consultation policies and practices in line with the best practices identified in the report.

Document Limitations: Not specific to Tribal consultation by DOE, nor does the report directly address nuclear waste specific factors influencing Tribal consultation.

Relevant Portions: Entire report, but especially:

- Section V (Tribal Comments) provides a summary of Tribal comments received in response to two consultation sessions held as part of report development.
- Section VII (Key Principles and Recommendations from the Work Group) provides lists of fundamental principles for Tribal consultation and best practices for Tribal consultation processes.

Relevant Key Points:

- Federal agencies have "ample opportunity" to improve on their commitments to honor Tribal treaty and reserved rights. The working group recommends that continued coordination among departments and agencies occur to harmonize consultation terms and policies regarding treaty and reserved rights—incorporating additional Tribal consultation as necessary.

9.3 Summary Observations

When examining the above references in aggregate, key themes emerge and can be used to craft summary observations regarding Tribal engagement as part of the CBS Consortia's research. These summary observations are provided below in Table 8.

Table 8. Emergent themes in Tribal engagement literature, with summary observations for DOE's CBS Consortia.

Emergent Theme	**Summary Observation for CBS Consortia**
DOE maintains a government-to-government relationship with Tribal Nations.	The CBS Consortia should understand the principles of this government-to-government relationship before engaging with Tribal Nations.
No two Tribal Nations are the same. Each has its own history, culture, etiquette, traditions, land base, values, etc.	Do your homework before reaching out to each Tribal Nation. Use the resources in this chapter, and others you may identify, to know what types of questions need to be asked and answered before beginning engagements.
Building a relationship based on trust and respect is an essential first step to engaging Tribal Nations.	Allot sufficient time to engage with the Tribal Nations. Do not expect to address all subjects of interest in your first contact with each Tribal Nation.

Emergent Theme	Summary Observation for CBS Consortia
Tribal Nations can be both economically and engagement[38]-overburdened.	Consider the time and financial commitments required for Tribal Nations to participate in engagements. If possible, identify opportunities (e.g., compensation, childcare) to offset the burden of participating in engagements.
Engaging with American Tribal Nations requires additional considerations beyond the preparations performed for engaging with non-Tribal stakeholders.	Some additional factors that the Consortia should consider when preparing for Tribal engagements include: (1) Traditional knowledge and its accompanying value systems may not follow other stakeholder's basic assumptions and expectations of temporality or reality; (2) clear consensus should be sought and agreed upon at all stages of interaction, even in non-obvious areas (e.g., taking photographs, recording and disseminating Tribal knowledge); (3) language and translation should be carefully considered—retranslating and verifying the meaning and intention behind communications from either side of discussion can help prevent misunderstandings and improve accuracy; and (4) traditional knowledge is often based on oral, rather than written, documentation, requiring researchers and practitioners to adapt their methods.

[38] The term engagement-overburdened refers to the phenomenon in which Tribal Nations and their members (as well as other communities and groups) are inundated with requests to voluntarily participate in research, engagements, or other activities that they do not have the time or resources to support.

Chapter 10: Conclusions and Observations for Future Research

10.1 Conclusions

This report documents the first edition of the CBS BoK. Internally, CRESP intends to use the BoK as a supplement to the project team's experiential knowledge to help complete Milestones 2 and 3 (described in Table 1) of the CBS project. However, in addition to CRESP's specific workscope, each awardee within the Consortia has been tasked with community and stakeholder engagement and the development of strategies to support mutual learning. The BoK is thus intended to be useful to DOE's CBS Consortia and others participating in DOE's CBS endeavors to help establish a common basis among the Consortia.

The BoK is intended to be a living document which CRESP will maintain throughout the duration of the project. CRESP retains the responsibility to update the BoK if and when the project team determines it to be a necessary and value-added evolution. This BoK is also intended to be a participatory document that reflects the viewpoints of those communities with ties to developing the process used for CBS of a federal CISF. Correspondingly, CRESP also envisions the BoK itself as a tool to be used to support stakeholder and Tribal engagements as part of the Consortia work and beyond.

10.2 Observations for Future Research

A multitude of references were reviewed as part of the development of this BoK. In reviewing these references, the authors of the BoK have identified general observations for future research and resource development to support CBS of radioactive waste management facilities generally. These observations are provided below.

- Many fields outside the nuclear industry involve areas of knowledge identified in this BoK as being relevant to CBS of facilities. Although some differences exist in the nuclear industry, an opportunity exists to better integrate knowledge from outside the industry into CBS processes.
- Guidelines and resources that support selection of consensus building tools and participatory decision-making methods appear somewhat dated (most prior to 2010), and do not reference state of the art methods (e.g., STMCE, knowledge exchange portals, open process workshop)

that have been developed in the past 5-10 years. The community of practice might benefit from updated guidelines for selecting and implementing these methods and tools.

- The ethics of siting facilities for managing (or disposing of) radioactive material have been widely discussed in case study format. In some instances, these case studies consider well-known philosophical frameworks[39]. It may be valuable to develop a comprehensive summary of the existing case study literature within the context of these philosophical frameworks to support consistent, multinational understandings.
- DOE has recognized the need to develop qualitative performance metrics to gauge CBS practices. The emergent themes presented in Chapters 4-9 of the BoK may provide initial insights into metrics development. We have attempted to provide an initial list of performance metrics in Table 9 below. The extrapolation of these metrics to the emergent themes of the BoK can be found in Appendix C.
- CBS literature for nuclear sites is generally broken into deep geologic repository- and interim storage facility-specific case studies and reflections. However, each subject on its own is not sufficiently mature to identify separate insights for CBS. Thus, it may be useful to develop a comparison of technical, socio-technical, ethical, etc. similarities and differences between deep geologic repository siting and interim storage facility siting in order to understand the limitations of each.
- Finally, we have observed the literature on CBS to be dynamic, which is to be expected given the significant research attention being given to the topic. For example, even between pre-release revisions of the BoK, additional relevant manuscripts had been published and needed to be added to the BoK. We thus conclude that keeping the BoK up-to-date will require significant resources and constant effort as the subject matter matures.

Table 9. Potential qualitative performance metrics for CBS.

BoK Chapter/Subject	Potential Qualitative Performance Metric
Chapter 4: Best Practices for Risk Communication and Engagement	• The risk communication approach adopts collaborative, two-way risk communication, and integrates stakeholder and Tribal knowledge. • Risk communication plans clearly address time and resource needs; schedule and funds are consistent with needs. • The risk communications approach is adequately documented including the rationale for its selection.

[39] E.g., John Rawls framework of "Justice as Fairness." (Rawls, 1958)

BoK Chapter/Subject	Potential Qualitative Performance Metric
	• Risk communication approach acknowledges the importance of trust in engagement planning and performance and integrates trust building activities. • Communication and engagement approach considers the role played by crisis management as the engagement evolves.
Chapter 5: Participatory Decision-Making Methods, Tools, Frameworks, and Best Practices	• Overall communications approach incorporates mechanisms to ensure flexibility and adopts a schedule that acknowledges this need.
Chapter 6: Reflections on the Ethics of Facility Siting and Process Rulemaking	• The siting process acknowledges challenges in participatory governance and decision-making and has plans for addressing them. • The siting process crosses disciplinary boundaries and seeks to build sustained socio-technical capacities. • The siting process recognizes, accepts, and adapts to sociological knowledge gaps, tailors methods, and hedges against uncertainties. • The siting process acknowledges the need to work within value frameworks of local communities includes plans for monitoring community perceptions of the approach and adopts course corrections when indicated. • The siting process seeks to understand community-specific inter- and intra-generational concerns and looks to provide community with enduring benefits.
Chapter 7: The Role of Negotiations and Compensation in CBS	• Negotiation & compensation planning addresses the complexities of compensation. • Negotiation & compensation planning reflects an understanding of community needs and values and seeks to address these during negotiations.
Chapter 8: Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting	• The siting process accounts for the preferences, values, demographics, and culture of potential host communities. • The siting process incorporates mechanisms to address representative voices in each community engagement. • The siting process honors the role that dissenting voices in communities can play and uses that information to incorporate process improvements.
Chapter 9: Recommendations for Tribal Engagement	• The siting process acknowledges and integrates understanding of government-government relationship with Tribal Nations. • The siting process includes preparation for engaging with specific Tribal Nations—and provides sound rationale for the methods/tools selected. • The siting process allocates sufficient resources for preparing to engage with involved Tribal Nations and adequate time for implementation. • The siting process includes funding to offset the burden of participating in engagements with all communities, and especially Tribal Nations.

BoK Chapter/Subject	Potential Qualitative Performance Metric
	• The siting process acknowledges and engages according to individual Tribal etiquette practices and honors and integrates traditional knowledge.

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Appendix A: Examples of Keywords Searched for BoK Compilation

Note: Keywords may have been used in conjunction with specifying descriptors. For example, "risk communication" would be appended with "nuclear waste" or "Chernobyl" with "policy response" to improve specificity when desired.

- Chernobyl
- Citizens advisory board
- Collaboration-based siting
- Communication engagement
- Community engagement
- Compensation
- Consolidated interim storage facility
- Controversial facility siting
- Co-siting
- Distributive justice
- Fairness
- Fukushima
- Hazardous facility siting
- Indigenous traditional ecological knowledge (ITEK)
- Interim storage
- Negotiations
- Nuclear energy policy
- Nuclear repository
- Nuclear waste
- Nuclear Waste Management Organization (NWMO)
- Nuclear Waste Policy Act (NWPA)
- Participatory decision-making
- Procedural justice
- Public acceptance
- Public engagement
- Public trust
- Radioactive waste management
- Recognition justice
- Referendum
- Risk analysis
- Risk assessment
- Risk communication
- Risk perception
- Site-specific advisory board
- Siting
- Social amplification of risk
- Social trust
- socio-technical knowledge
- Spent nuclear fuel (SNF)
- Stakeholder communication
- Traditional knowledge
- Tribal engagement
- Uncertainty evaluation
- Voluntarism
- Waste disposal
- Waste siting
- Waste storage
- Wicked problems
- Yucca mountain

Appendix B: BoK Database User's Guide, Rev. 1

CBS BoK Database User's Guide

This guide is intended to help users navigate and input records to the CBS BoK Database. The contents of this guide include:

- A description of the database layout.
- A description of how to add a database record using the CBS BoK Data Input Form.

Database Layout

When you first open the Microsoft Access CBS BoK database template, a window similar to that below should appear.

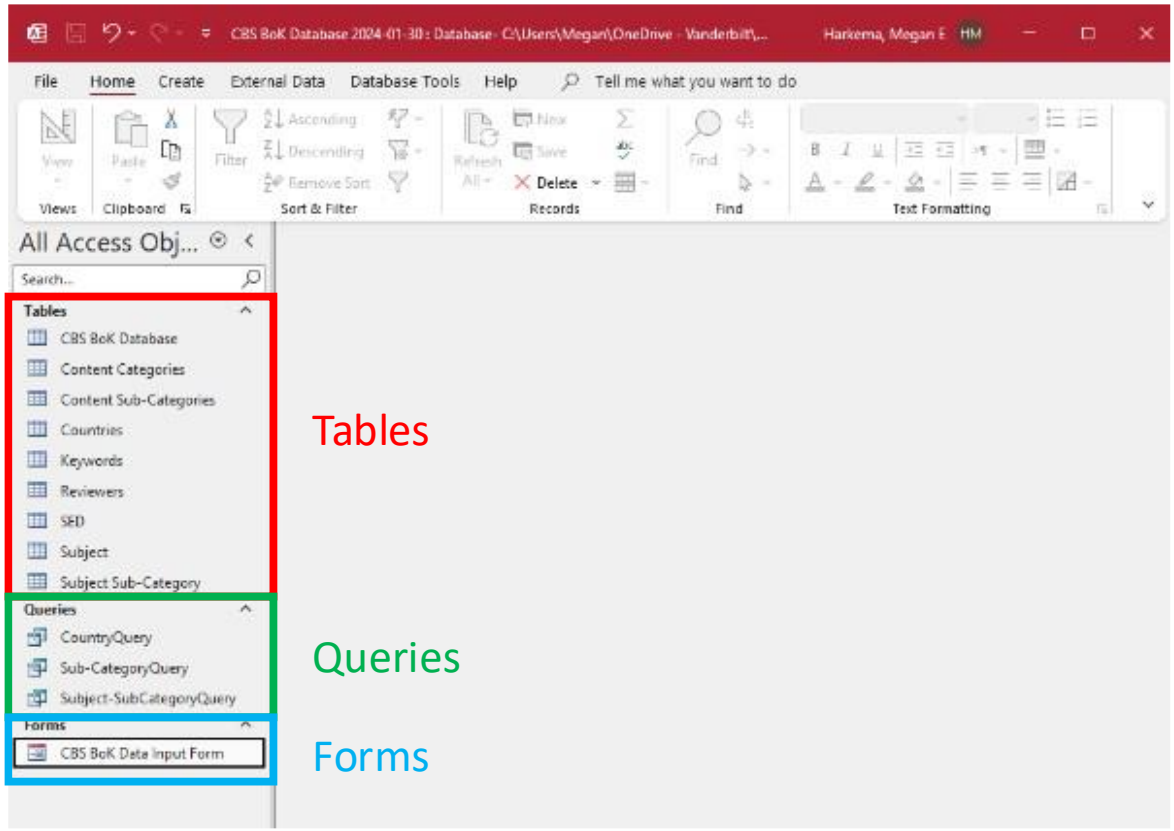


Figure 3. Layout of BoK database.

The database consists of the following tables, queries, and forms. **Data should only be input to the CBS BoK Data Input Form. Do not modify the tables or queries directly.**

- Tables
    - CBS BoK Database: This is where the BoK database records are stored. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.

- Content Categories: These are the types of content that records can be stored as (e.g., articles, books, etc.), primarily taken from the categories found within the CURIE library. This table is linked to the CBS BoK Database table. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.
- Content Subcategories: These are the subcategory content types that records can be stored as (e.g., articles can be journal articles, news articles, or proceedings articles), primarily taken from the subcategories found within the CURIE library. This table is linked to the CBS BoK Database Table and the Sub-CategoryQuery. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.
- Countries: These are the countries that records considered to be siting experience documents can be assigned to, primarily taken from the country list found in CURIE. This table is linked to the CBS BoK Database table and the CountryQuery. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.
- Keywords: These are the keywords that can be assigned to a record, primarily taken from the keyword list found in the CURIE library. This table is linked to the BoK Database table. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.
- Reviewers: This table contains the name of each document reviewer on the team. This table is linked to the CBS BoK Database table. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.
- SED: CURIE allows a user to search specifically for “siting experience documents” or “SEDs.” It generally appears that documents in CURIE categorized as such are documents that pertain to actual siting experience from the U.S. or abroad. The SED table is linked to the CBS BoK Database field that allows users to assign “yes” or “no” to the question “Does the document pertain to actual siting experience from the U.S. or abroad?” DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.

- Subject: These are the subjects that a record can be stored as, primarily taken from the subject list found in the CURIE library. This table is linked to the CBS BoK Database table. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.
- Subject Sub-Category: For each subject assigned to a record, a subcategory can also be assigned. These are also primarily based on the sub-categories found in the CURIE library. This table is linked to the CBS BoK Database table and the Subject-SubCategoryQuery. DO NOT INPUT DATA DIRECTLY TO THIS TABLE. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE TABLE ITSELF.

- Queries
  - CountryQuery: The country query links the SED table and Country table. Specifically, a country can only be assigned to a record if "yes" is selected in the SED field. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE QUERY ITSELF.
  - Sub-CategoryQuery: The Sub-CategoryQuery links the Content Category table and the Content Sub-Category Table. Specifically, it allows a user to select only an allowable content sub-category for the content category selected. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE QUERY ITSELF.
  - Subject-SubCategoryQuery: The Subject-SubCategoryQuery links the Subject table and the Subject Sub-Category Table. Specifically, it allows a user to select only an allowable subject sub-category for the subject selected. DO NOT MAKE ANY CHANGES TO THE DESIGN OR CONTENTS OF THE QUERY ITSELF.
- Forms
  - CBS BoK Data Input Form: This is the form that should be used to input records to the CBS BoK Database. The form is described further in the next section.

Adding a Record Using the CBS BoK Data Input Form

The first step to adding a new record to the CBS BoK Database using the Data Input Form is to open the form itself by double clicking on the tab shown in blue in Figure 1 above. This should open the form—an example is shown in Figure 4 below.

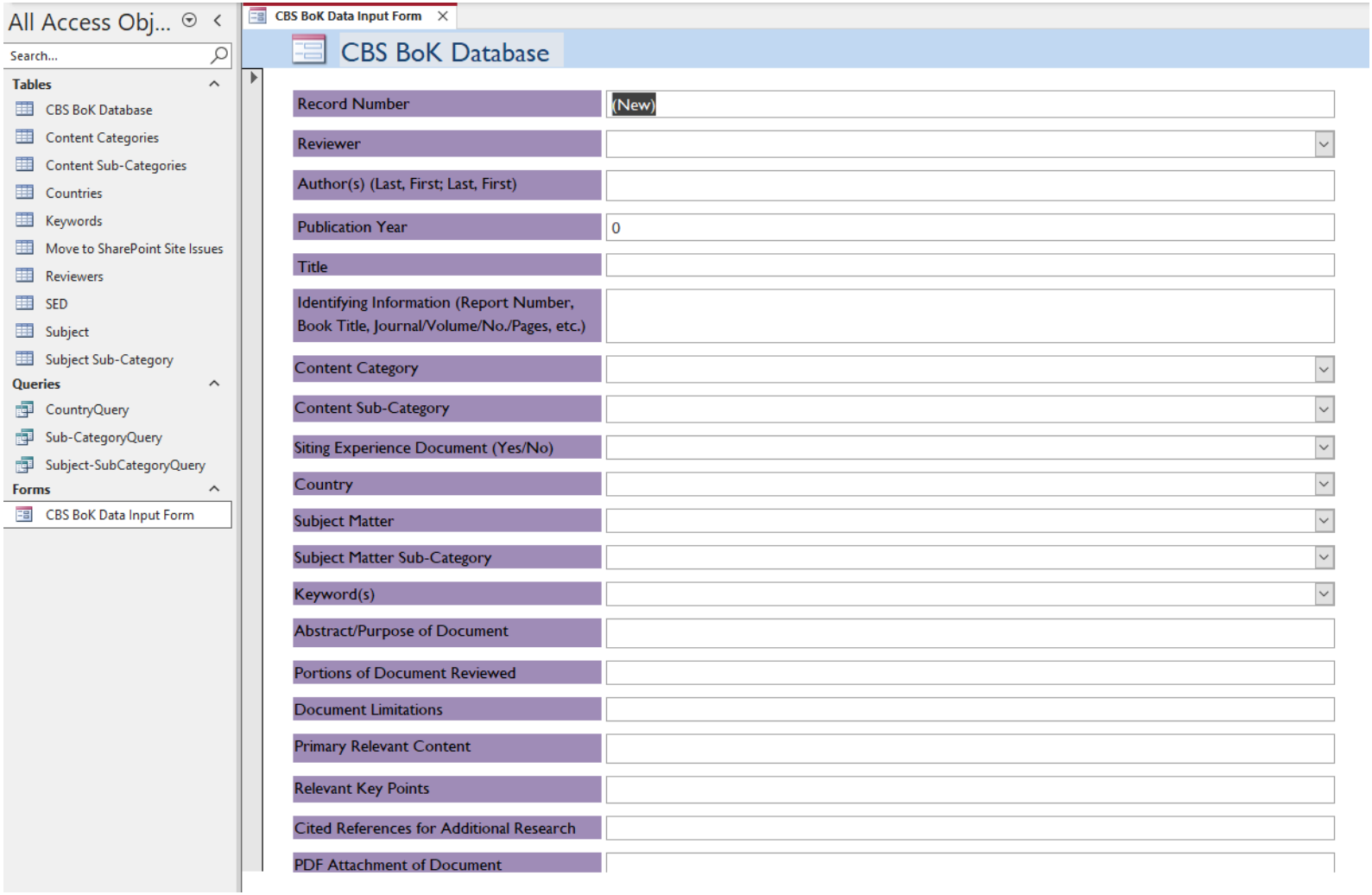
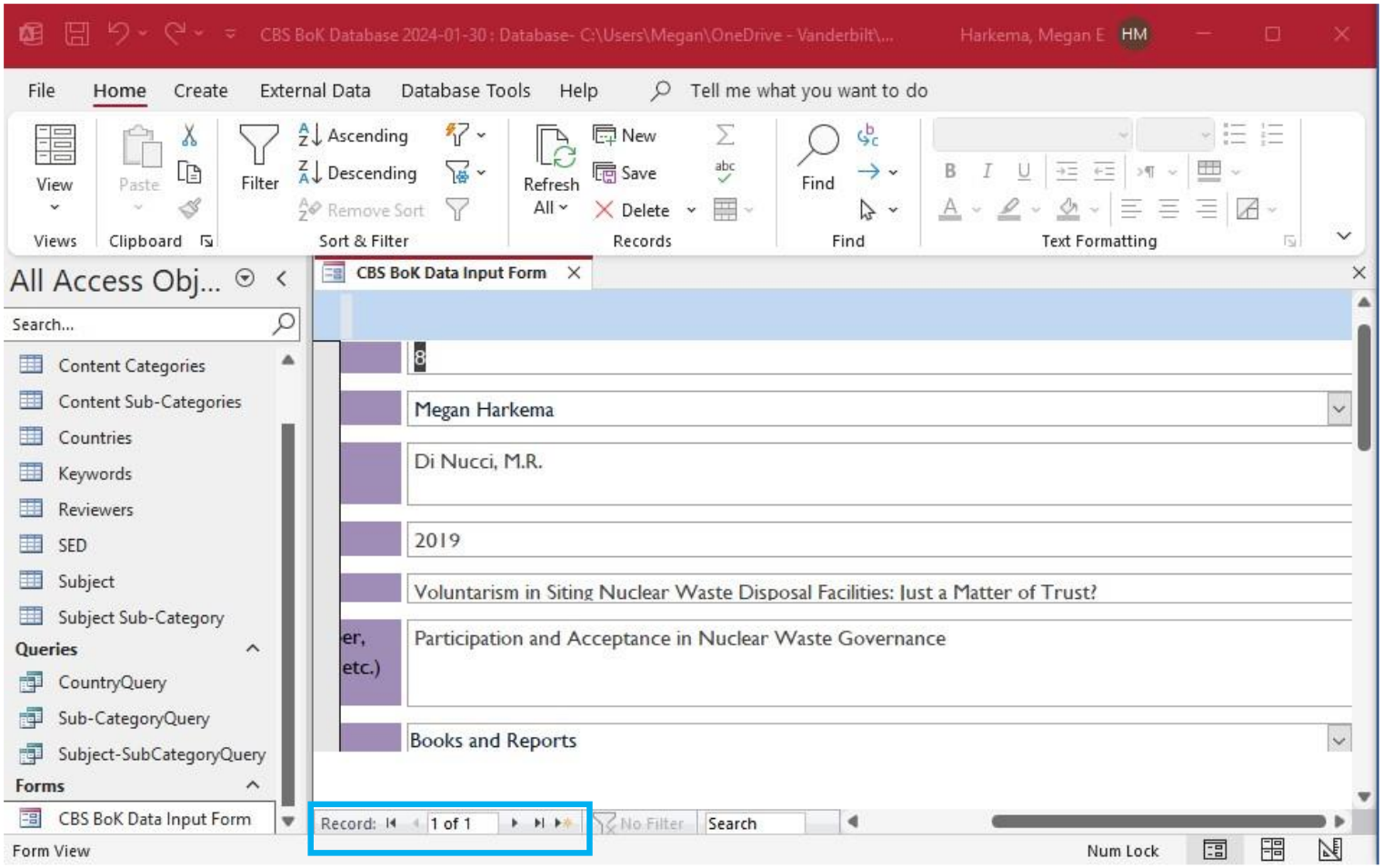


Figure 4. Data input form for CBS BoK database.

If the form opens to an existing record (i.e., there is data in the right-hand side of the columns in Figure 2), then, as shown in Figure 5 below, either use the right arrows to page over until you reach a blank/new record or click the right arrow+yellow star to directly create a new record.



Use these to navigate/create new records

Figure 5. How to navigate through existing records in BoK database.

Each of the fields and their allowable inputs are described below.

- Record Number
    - Description: This field stores the unique identifier for each record in the database. It is automatically generated by Microsoft Access when data is entered in other fields.
    - Field Type/Size: Long integer
- Reviewer
    - Description: This field stores the name of the document reviewer from our team. Select your name from the dropdown list when adding a new record. Options include:
        - Brennan Ferrington
        - Catherine Knox
        - Hank Mayer
        - Megan Harkema
        - Mike Greenberg
        - Steve Krahn
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Author(s)
    - Description: This field stores the name of the authors of the document for a record. Author names should be inserted “Last, First; Last, First; Last, First” or “Last, First Initial; Last, First Initial; Last, First Initial.” If no individual author names are listed, use this field to store the organization name that produced the report.
    - Field Type/Size: Long text
- Publication Year

- Description: This field stores the year that the document was published. It only accepts the year—not the month or date of publication.
- Field Type/Size: Number—long integer

- Title
  - Description: This field stores the title of the document. When inserting a record for a journal article, proceedings article/conference paper, or chapter within a book, please only put the title or the article or chapter in this field. (Other identifying information such as the journal name or book name should be recorded in the "Identifying Information" field.)
  - Field Type/Size: Long text
- Identifying Information
  - Description: This field stores other identifying information for a document. This is a freeform category but should include any other information needed to cite the document. For example:
    - Articles: Journal Name, Volume, Number, Page Numbers
    - Chapter in Book: Book Name, Publisher, Publisher Location, Editors (if applicable)
    - Book: Publisher, Publisher Location, Editors (if applicable)
    - Report: Report Number/Identifier, Agency/Publisher Name (e.g., Oak Ridge National Laboratory), Agency/Publisher Location
    - Dissertation/Thesis: University Name, University Location
    - Internet Content: website publishing date, website access date, link to website
  - Field Type/Size: Long text
- Content Category
  - Description: This field stores the category of the document/content within one of the following predefined options:
    - Articles
    - Books and Reports

        - Correspondence
        - Data
        - Graphic
        - Internet Content
        - Legal Documents
        - Procedures and Process Requirements
        - Video/Audio
        - Dissertation/Thesis
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Content Sub-Category
    - Description: This field stores the sub-category of the document/content. The options presented for the content sub-category depend on the content category selected. *Therefore, you must select a content category prior to selecting a content sub-category.*
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Siting Experience Document
    - Description: The siting experience document field allows users to assign "yes" or "no" to the question "Does the document pertain to DOE's international siting experience project?"
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Country
    - Description: If "no" is selected for the siting experience document field, then this dropdown list will show only one option "N/A" which should be selected. If "yes" is selected for the siting experience document field, then this dropdown list will show the following list of countries that the user should select from. If the document pertains to multiple countries, please select the first option and follow the instructions ('**Multiple countries—please specify in "Document Limitations"').

- **Multiple countries—please specify in “Document Limitations”
- Argentina
- Armenia
- Australia
- Belarus
- Belgium
- Brazil
- Bulgaria
- Canada
- China
- Croatia
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- India
- Indonesia
- Iran, Islamic Republic of

- Ireland
- Italy
- Japan
- Korea, Republic of
- Latvia
- Lithuania
- Luxembourg
- Mexico
- Morocco
- Netherlands
- Norway
- Pakistan
- Poland
- Portugal
- Romania
- Russian Federation
- Slovakia
- Slovenia
- South Africa
- Spain
- Sweden
- Switzerland
- Taiwan, Province of China

        - Turkey
        - Ukraine
        - United Arab Emirates
        - United Kingdom
        - United States
        - Uruguay
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Subject Matter
    - Description: This field allows the user to select the subject matter category that best applies to the document from the following predefined list:
        - CBS Processes and Policies
        - Disposal
        - Environmental Impacts
        - Management Systems
        - Power Conversion
        - Storage
        - Transportation
        - Waste Quantities
        - Risk Assessment and Communication
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Subject Matter Sub-Category
    - Description: This field allows the user to select the sub-category for the subject matter that best applies to the document from the following predefined list. Note that each sub-category is specific to the subject matter category selected in the above field.

Note that in CURIE, some subject matter categories do not have relevant sub-categories—in this case, the subject matter sub-category option is the same as the subject matter field selected.

- CBS Processes and Policies
  - CBS Processes and Policies
- Disposal
  - Repository and Disposal Requirements
  - Repository Postclosure Performance
    - Repository Siting
- Environmental Impacts
  - Cultural Resources
  - Native American Interests
  - Socioeconomics
  - Transportation
- Management Systems
  - Legal and Regulatory
  - Organization
  - Program Plans and Strategies
- Power Conversion
  - Power Conversion
- Storage
  - Inspection and Monitoring
  - Storage Costs
  - Storage Requirements

        - Transportation
            - Transportation
        - Waste Quantities
            - Inventories
        - Risk Assessment and Communication
            - Decision-Making Methods
            - Values Assessment
            - Trust
    - Field Type/Size: Short text (255 character maximum) dropdown list
- Keyword(s)
    - Description: This field allows the user to select relevant key words for the document from the following predetermined list (based on the same list found in CURIE). There is no limit to the number of keywords that can be selected.
        - Blue ribbon commission
        - Burnup credit
        - Criticality analysis
        - Disposal
        - High level waste
        - Joint convention
        - Radioactive waste management
        - Repository
        - Siting
        - Spent fuel
        - Spent fuel management

        - Storage
        - Used fuel
        - Waste management
        - Yucca mountain
        - Risk communication
        - Public engagement
        - Decision-making
    - Field Type/Size: Short text (255 character maximum) dropdown/checkbox list (select all that apply)
- Abstract/Document Summary
    - Description: This is a free-form field that can be used to record the abstract/purpose of the document. The abstract found in the document itself can be included, or one can be created by the reviewer and inserted here.
    - Field Type/Size: Long text
- Portions of Document Reviewed
    - Description: This is a free-form field that can be used by the reviewer to record what portions of the document were reviewed (e.g., section 1, chapter 5, full document, etc.)
    - Field Type/Size: Short text (255 character maximum)
- Document Limitations
    - Description: This is a free-form field that can be used by the reviewer to record Provide any important limitations, qualifications, context, etc. (e.g., only examined XX group of stakeholders or Tribes). If '**Multiple countries—please specify in "Document Limitations"' is selected in the countries field, then all countries discussed within the document should be recorded here.
    - Field Type/Size: Short text (255 character maximum)
- Relevant Portions

  - Description: This is a free-form field that can be used by the reviewer to list the sections/chapters/pages that are of primary relevance to the BoK (findings, methods, conclusions, recommendations, etc.).
  - Field Type/Size: Long text
- Relevant Key Points
  - Description: This is a free-form field that can be used by the reviewer to succinctly capture content worthy to be conveyed as findings and to be used to shape BoK conclusions/recommendations/etc.
  - Field Type/Size: Long text
- Cited References for Additional Research
  - Description: This is a free-form field that can be used by the reviewer to list references cited in the document that are potential candidates to add to the BoK.
  - Field Type/Size: Long text
- PDF Attachment of Document
  - Description: This field can be used to attach a copy of the document reviewed to the database record. Please make sure all attachments are PDFs.
  - Field Type/Size: PDF attachment of document reviewed

Appendix C: Potential Qualitative Performance Metrics for CBS

As discussed in Section 10.2, DOE has recognized the need to develop metrics to gauge the success of CBS practices and approaches. This appendix provides an initial list of potential qualitative success metrics for CBS approaches—developed systematically from the emergent themes from the BoK presented in Sections 4.3, 5.3, 6.3, 7.3, 8.3, and 9.3. These metrics, presented in the right-most column of Table 10 below use similar language to that found in the merit review criteria adopted for many DOE funding opportunity announcements, including DE-FOA-0002575—the funding vehicle for this work. We perceive that these metrics might be of use to various audiences. First, DOE might use these metrics as part of a self-assessment of their own CBS approach both now and in the future, and as part of the merit review criteria for future funding opportunities related to the CBS process. Second, these metrics might be of use to a community considering hosting a facility for managing (or disposing of) radioactive material; e.g., these metrics could be used to assess the approach of an organization looking to site a facility, or as part of evaluating a proposed benefits package.

Table 10. Qualitative success metrics suggested for CBS approaches.

BoK Chapter	Subject	Emergent Theme	Summary Observation for CBS Consortia	Potential Qualitative Metric
4	Best Practices for Risk Communication and Engagement	Many previous efforts in waste facility siting have exhibited failures due to unilateral downplaying of local concerns (e.g., distrust of authorities, site analysis, representation) in favor of 'scientific education' that has provoked backlash.	Practitioners should be careful to not fall into the attitude that risk communication is based on the "correction" of stakeholder attitudes.	**The risk communication approach adopts collaborative, two-way risk communication, and integrates stakeholder and Tribal knowledge.**
4	Best Practices for Risk Communication and Engagement	Planning for risk communication is essential, and should account for the values, histories, and demographics of audience(s) in question and the overall goal of the communication	Sufficient time and resources should be allocated to planning for public engagements, particularly those that entail communicating risks. Refer to the references in Section 4.2 for methods,	**Risk communication plans clearly address time and resource needs; schedule and funds are consistent with needs.**

BoK Chapter	Subject	Emergent Theme	Summary Observation for CBS Consortia	Potential Qualitative Metric
		effort. Sufficient time should be allotted for these preparations and planning efforts.	checklists, and metrics to successfully plan for risk communication activities.	
4	Best Practices for Risk Communication and Engagement	Risk communication should be a participatory activity—however, participation can take various forms. Selecting the appropriate risk communication methods and tools requires familiarity with the utility and pros and cons of available participatory tools and methods.	The rationale for the selection of risk communication methods and tools used during community engagements should be founded on sound logic and documented accordingly. Method selection should not be rationalized based on preconceived notions or past familiarity with a specific method or tool. If necessary, outside subject matter expertise on the appropriate tools for a risk communication effort should be sought.	**The risk communications approach is adequately documented including the rationale for its selection.**
4	Best Practices for Risk Communication and Engagement	Achieving successful risk communication requires a foundation of trust between project managers, subject matter experts, risk communicators, and the public.	Building and maintaining trust is a critical element of all project lifecycle stages for the CBS Consortia. Thought should be given to trust building and maintenance from the initiation of a risk communication activity.	**Risk communication approach acknowledges the importance of trust in engagement planning and performance and integrates trust building activities.**
4	Best Practices for Risk Communication and Engagement	Crisis communication is a critical aspect of risk communication and requires similar levels of preparation and planning as other risk communication efforts.	The definition of a "crisis" may be different during CBS—perhaps related to events that involve a loss of public trust; however, crisis communication	**Communication and engagement approach considers the role played by crisis management as the engagement evolves.**

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			strategy can be a tool in building trust and informing negotiations processes.	
5	Participatory Decision-Making Methods, Tools, Frameworks, and Best Practices	A number of tools, mechanisms, and frameworks exist to support community deliberation and participatory decision-making. Flexibility is required because method selection and implementation should seriously consider community preferences.	Build flexibility into engagement and participatory processes. Additional time may be required to revise approaches based on community feedback.	**Overall communications approach incorporates mechanisms to ensure flexibility and adopts a schedule that acknowledges this need.**
6	Reflections on the Ethics of Facility Siting and Process Rulemaking	Participatory governance/decision-making/etc. processes as used for radioactive waste management facility siting are generally considered to be a "normative good." However, in implementation, the scope, scale, and independence of the processes themselves have been critiqued.	The CBS Consortia should look for opportunities to assess impressions of the scope, scale, and independence of prior efforts in their planned engagements—and report back to DOE on lessons learned.	**The siting process acknowledges challenges in participatory governance and decision-making and has plans for addressing them.**
6	Reflections on the Ethics of Facility Siting and Process Rulemaking	Radioactive waste management facility siting is inherently an interdisciplinary, socio-technical challenge.	The CBS Consortia teams should look for opportunities to cross disciplinary boundaries during their research, and address methods they encounter to build sustained interdisciplinary, socio-technical capacity.	**The siting process crosses disciplinary boundaries and seeks to build sustained socio-technical capacities.**
6	Reflections on the Ethics of Facility Siting and Process Rulemaking	Although socio-technical elements of radioactive waste management facility siting are important research topics to be	Until advancements are forthcoming, practitioners should recognize, accept, and adapt to this knowledge gap by	**The siting process recognizes, accepts, and adapts to sociological knowledge gaps,**

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		addressed, purely sociological advancements are also required. The sociological understanding of how individuals and communities process information, assess risks, and make decisions—especially as informed by socio-cultural environments—remains poorly understood and requires further study.	tailoring methods to different socio-cultural climates and hedging against uncertainties. (Johnson & Swedlow, 2021) It may also be necessary to approach specific research questions from a purely sociological perspective (e.g., how communities shift from "disagreement to antagonism") in assessing the socio-cultural assumptions behind siting problems.	**tailors methods, and hedges against uncertainties.**
6	Reflections on the Ethics of Facility Siting and Process Rulemaking	Several aspects of the communication and siting processes can create dilemmas in ethical practice: transparency can improve trust but decrease confidence; consistency can improve trust and confidence but appear inflexible, thus, lessening confidence-building; and generality in requirements to facilitate local input can reduce confidence.	A collaboration-based approach requires one to work within—and thus understand—the value framework of local communities. Iterative approaches informed by community input may be valuable. Real-time, community-specific characterizations of the ethics of processes may allow for timely course correction.	**The siting process acknowledges the need to work within value frameworks of local communities includes plans for monitoring community perceptions of the approach and adopts course corrections when indicated.**
6	Reflections on the Ethics of Facility Siting and Process Rulemaking	The long-lived hazards posed by SNF tend to subject facility siting to concerns about multigenerational risk management concerns.	Although this theme is more relevant to repositories due to their long operational lifetime, opportunities to manage inter- and intra-generational risk considerations may also exist for a	**The siting process seeks to understand community-specific inter- and intra-generational concerns and looks to provide**

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			CISF, e.g., are there enduring benefits a community can expect from siting a CISF?	**community with enduring benefits.**
7	The Role of Negotiations and Compensation in CBS	Compensation/benefits alone do not necessarily result in successful siting process. However, compensation can help offset perceived risks with siting hazardous facilities and should be viewed as key element of an overall collaboration-based approach to siting.	Compensation should be viewed as an essential element of negotiating a successful CBS of a CISF. However, the Consortia should be cognizant of the following precautions when discussing compensation: (1) for compensation to be effective, it should be combined with mitigation of any unacceptable risks; and (2) compensation can appear ethically ambiguous (e.g., some can view compensation as "bribery").	**Negotiation & compensation planning addresses the complexities of compensation.**
7	The Role of Negotiations and Compensation in CBS	Compensation/benefits can come in a variety of forms, which include direct and indirect benefits from the facility itself, additional investments in local infrastructure, additional activity, specific subsidies and grants, offering support in the form of training and logistics, and setting up community funds for local development.	Compensations/benefits packages for a future federal CISF are likely to be site-specific and should reflect the needs and values of the local community. It may be the case that variegated benefits (e.g., funding emergency response personnel/training, transportation upgrades, income/property tax reductions, etc.)	**Negotiation & compensation planning reflects an understanding of community needs and values and seeks to address these during negotiations.**

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			will best address the concerns and needs of the community in question.	
8	Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting	Community-specific processes, tools, and participation opportunities are critical to achieving successful CBS.	Account for the preferences, values, demographics, and culture of communities when crafting engagement approaches.	**The siting process accounts for the preferences, values, demographics, and culture of potential host communities.**
8	Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting	Powerful actors and dominant voices can impact public decisions and perceptions—and thus the perceived fairness of the siting process.	Develop mechanisms to identify and include representative voices present in community engagements.	**The siting process incorporates mechanisms to address representative voices in each community engagement.**
8	Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting	Dissenter voices can be important to listen to--they can help identify and address process flaws.	Consider giving dissenting voices a platform to convey their message. Use that message to identify process improvements.	**The siting process honors the role that dissenting voices in communities can play and uses that information to incorporate process improvements.**
8	Descriptions and Critiques of International Experience with Radioactive Waste Management Facility Siting	Legal jurisdictions and socio-political boundaries can be sources of conflict during siting because they can influence benefits package acceptance, definition of the public(s) involved in the decision making process, justice considerations, etc.	Research and account for legal jurisdictions and socio-political boundaries when planning for engaging the community.	**The siting process accounts for community-specific jurisdictional and socio-political boundaries when planning/performing engagements and negotiating benefits packages.**
9	Recommendations for Tribal Engagement	DOE maintains a government-to-government relationship with Tribal Nations.	The CBS Consortia should understand the principles of this government-to-	**The siting process acknowledges and integrates understanding of**

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			government relationship before engaging with Tribal Nations.	**government-government relationship with Tribal Nations.**
9	Recommendations for Tribal Engagement	No two Tribal Nations are the same. Each has its own history, culture, etiquette, traditions, land base, values, etc.	Do your homework before reaching out to each Tribal Nation. Use the resources in this chapter, and others you may identify, to know what types of questions need to be asked and answered before beginning engagements.	**The siting process includes preparation for engaging with specific Tribal Nations—and provides sound rationale for the methods/tools selected.**
9	Recommendations for Tribal Engagement	Building a relationship based on trust and respect is an essential first step to engaging Tribal Nations.	Allot sufficient time to engage with the Tribal Nations. Do not expect to address all subjects of interest in your first contact with each Tribal Nation.	**The siting process allocates sufficient resources for preparing to engage with involved Tribal Nations and adequate time for implementation.**
9	Recommendations for Tribal Engagement	Tribal Nations can be both economically and engagement-overburdened.	Consider the time and financial commitments required for Tribal Nations to participate in engagements. If possible, identify opportunities (e.g., compensation, childcare) to offset the burden of participating in engagements.	**The siting process includes funding to offset the burden of participating in engagements with all communities, and especially Tribal Nations.**
9	Recommendations for Tribal Engagement	Engaging with American Tribal Nations requires additional considerations beyond the	Some additional factors that the Consortia should consider when preparing for Tribal engagements	**The siting process acknowledges and engages according to individual Tribal etiquette**

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		preparations performed for engaging with non-Tribal stakeholders.	include: (1) Traditional knowledge and its accompanying value systems may not follow other stakeholders' assumptions and expectations of temporality or reality; (2) clear consensus should be sought and agreed upon at all stages of interaction, even in non-obvious areas (e.g., taking photographs, recording and disseminating Tribal knowledge); (3) language and translation should be carefully considered—retranslating and verifying the meaning and intention behind communications from either side of discussion can help prevent misunderstandings and improve accuracy; and (4) traditional knowledge is often based on oral, rather than written, documentation, requiring researchers and practitioners to adapt their methods.	**practices, and honors and integrates traditional knowledge.**